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107—Journal Section of the American Society of Heating and Ventilating Engineers

Snowfalls up to 12 in. have been quickly melted from 600 ft roadway (see page 71)

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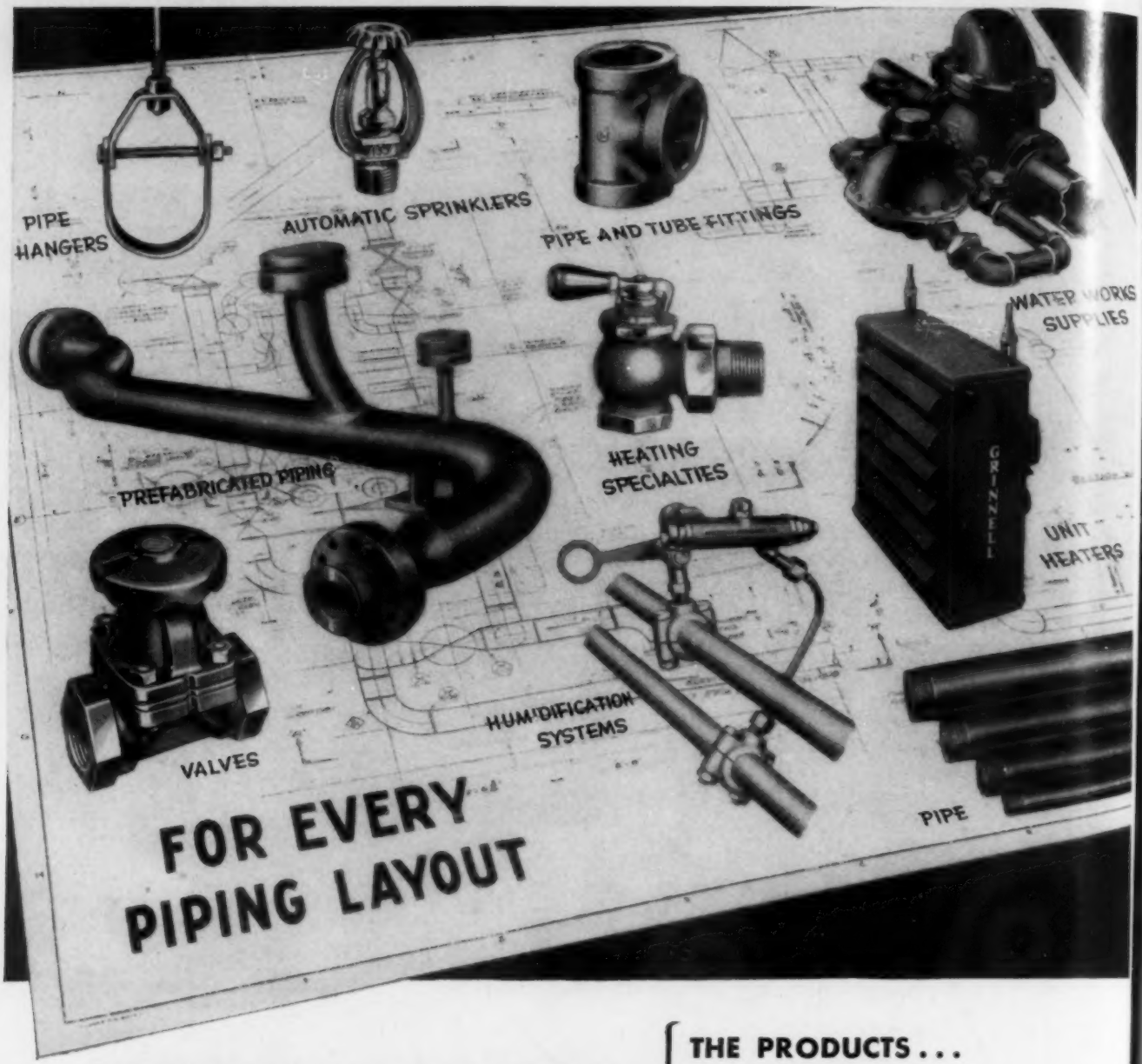

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THE EDITOR'S PAGES

SEEKS LEGISLATION FOR TEXTILE AIR CONDITIONING

A most unusual publication on air conditioning was recently issued—a research department technical report of the Textile Workers Union of America (CIO), 99 University Pl., New York 3, N. Y., on the subject of air conditioning in textile mills. Tabbed with the line "for better work from healthier workers," it presents "the case for temperature and humidity control to provide comfort, health, safety, and optimum production."

In a foreword by Emil Rieve, general president, it is stated that, historically, "the textile industry has suffered from a great liability" as "jobs were performed in uncomfortable, exhausting temperatures and humidities. Serious difficulties develop in textile mills when atmospheric conditions become unbearable. Complaints of workers multiply. Tension between labor and management mounts."

The science of air conditioning, says the foreword, has sufficiently advanced to assure control of both temperature and humidity in textile mills.

A resolution adopted at the union's convention last April is given, wherein it is stated that the union seeks legislation in the respective states requiring employers to maintain atmospheric conditions no higher than an effective temperature of 80 deg. A "model bill" to expedite adoption of the union's program is also included.

The booklet also includes a glossary of air conditioning terms, sections on effective temperature and its measurement, and descriptions of various types of air conditioning equipment used in the textile industry.

POINTS WAY FOR MODEL LABOR RELATIONS

Amicable labor relations in the building industry point the way for improved labor-management understanding in other industries, in the opinion of Peter W. Eller, president of the Building Trades Employers' Association of New York City, vice chairman of Thompson-Starrett Co., and a former national referee of the building and construction trades department of the American Federation of Labor.

Writing in the November issue of the Elks magazine, Mr. Eller described the plan for the prevention of jurisdictional strikes in force in New York, and declared that since 1937 there have been only three serious strikes on construction work covered by agreement accepted by 200,000 mechanics.

"I think the country as a whole would be standing today on a firmer economic footing if every major industry could make the same claim to good labor-management relations," he said. "After agriculture, the construction business is No. 2 in the nation in annual dollar volume and first in employment opportunities. It is the most reliable indication we have whether or not the United States is healthy or sick economically.

"There is not much difference between building a house or a nation's economy. In both instances you must have a strong foundation. And the only foundation on which labor-management relations can be built is collective bargaining, entered into by all parties with good faith, sincere performance, and a willingness to listen to the other fellow's side of the story."

HERE'S ONE WAY TO SAVE YOUR FEET

"Foot trouble" seems to be about the most common complaint heard around a big industry show like the Ninth International Heating, Ventilating and Air Conditioning Exposition to be held in Chicago's International Amphitheater from January 24 through January 28. One way to cut down the wear and tear on your pedal extremities when you visit the exposition is to do some planning ahead of time.

This is where HPAC's January issue comes in. A special Show Section to be published next month will list the names of all exhibitors, their booth numbers, the products and services they will display, and the names of the men in attendance at the various booths. It will reach you well in advance of the opening date so that you can look over the exhibit listings, note what you particularly want to see, spot the booth locations on the accompanying diagram of the exhibit hall, and plan your tour of the exhibits to save your feet, save your time, and so you won't miss something you might otherwise overlook.

Our own staff will be on the job at our booth—No. 525. We'll be glad to see you there, and will have information available on the exposition, the ASHVE meeting, and other data.

If you don't attend the meeting and exposition in Chicago next month, we are sure that you'll find the Show Section in our January issue of value in keeping you posted on new equipment and equipment developments.

E. J. GOSSETT HEADS HEATING BUREAU

E. J. Gossett, president of the Bell & Gossett Co., was elected president of the Plumbing and Heating Industries Bureau at the 29th annual meeting in Chicago.

Other officers elected are George O. Toepfer, of the Maag Co., vice president; Earl E. Brown, Chicago Faucet Co., treasurer; and Norman J. Radder, secretary.

TWO EDITORIAL FEATURES COMING NEXT MONTH

1) **Sixteenth annual Directory Section of Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional, and Public Buildings.**

2) **Show Section with complete information on the Air Conditioning Exposition—the Ninth International Heating & Ventilating Exposition—and the 55th annual meeting of the American Society of Heating and Ventilating Engineers, to be held in Chicago the last week of January.**

These features are in addition to HPAC's regular editorial content, including the Journal Section of the American Society of Heating and Ventilating Engineers.

Until then, best wishes for a MERRY CHRISTMAS & A HAPPY NEW YEAR!

THE EDITOR'S PAGES

INDEX FOR 1948 AVAILABLE ON REQUEST

An index for our 1948 issues, Vol. 20, Nos. 1-12, including the Journal Section of the American Society of Heating and Ventilating Engineers, is being compiled and will be available soon to HPAC's subscribers on request. If you want a free copy, send a note or postcard to The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

URGES GAS AND COAL FOR HEATING

Speaking at the annual convention of the American Petroleum Institute last month in Chicago, R. H. Hargrove, president of the Texas Eastern Transmission Corp., Shreveport, La., urged that the natural gas, oil, and coal industries work out plans for sharing markets in the best interests of the public. Oil fuels, he pointed out, are essential to military needs whereas gas and coal as well as oil are adapted to heating.

Demand for gas for heating has soared, he said, because of its low cost in relation to other fuels. He recommended that the industry and all regulatory bodies reconsider the present rate-making policies so as to give consideration to the present competitive position in the fuel industries.

TO STUDY MAN AND HIS ENVIRONMENT

A recent meeting on the Urbana campus of professors from the Chicago professional colleges and the local campus of the University of Illinois marked the establishment of a new physical environment unit which will function on both campuses. The new unit is the result of 10 years of planning fostered by President-Emeritus A. C. Willard and encouraged by Dr. F. W. Keeton, head of the department of medicine, and Prof. M. K. Fahnestock, of the mechanical engineering department.

A wide variety of research projects will be conducted under the direction of Dr. John P. Marbarger, director of research for the unit. Some of them may result in new treatments for old diseases. As Dr. Keeton expressed it, the new unit will provide facilities for studies "of man's adjustment to his environment."

Among the many projects will be studies of the effect of air conditioning on people, climate on persons with certain diseases, weather on nutrition requirements of animals, and high altitude on the amount of blood pumped out by the heart. Projects of vital interest to the psychology, physiology, animal nutrition, mechanical engineering, and physical education departments will be undertaken.

It has been common practice for years to control temperature, humidity, etc., in laboratories where scientists are working with small animals, thus removing the variable of climate from research findings, but up to now that hasn't been done for humans. Now, with the aid of a low pressure chamber on the Urbana campus and three chambers in Chicago, detailed studies can be conducted with humans.

ELECTED PRESIDENT OF WELDING SOCIETY

The American Welding Society has elected George N. Sieger, president of the S-M-S Corp., as its president for 1948-49.

A national authority on resistance welding, he is a past president of the Resistance Welder Manufacturers Association.

BIG EXPANSION TO MEET POWER NEEDS SEEN

Public utility companies in the United States will have to spend about $16 billion for new and improved generating and distribution facilities, within the next 10 years, according to Tomlinson Fort, manager of central station sales for the Westinghouse Electric Corp., in a recent address before senior engineering students at Pennsylvania State College.

Production of electric power in this country must be increased from slightly over 250 billion kwhr to [illegible]0 billion to supply a demand that [illegible]ll nearly double within the next d[illegible]-ade. An expansion of the gener[illegible]-ing capacity of this country fro[illegible]2 to over 95 million kw will be [illegible]e-quired to produce this power. In money this means that the electric power business of the United States probably will have to double its investment over the next 10 years.

AIR CONDITIONING CONSULTANT HEADS ASME

James M. Todd, consulting engineer of New Orleans, has been elected president of the American Society of Mechanical Engineers, the society has announced following tabulation of letter ballots of the membership.

In 1928 he established private practice as a consulting mechanical and electrical engineer, specializing in air conditioning, power plants, and the equipment of large buildings and factories.

15 Years Ago

One-eighth to seven-eighths of the power consumed by half of the fans under their charge can be saved by plant and operating engineers during part or all of each year without lowering appreciably the quality of the service, according to Robert W. Drake in an article in the December 1933 HPAC. He outlined in practical manner the advantages to be gained by occasional changes in fan speeds.

* * * * *

Neither dimensional piping standards nor piping materials specifications would be sufficient independently, since the adequacy of either depends upon what is used for the other. This was brought out in Sabin Crocker's article on piping standardization in HPAC's December 1933 issue.

* * * * *

R. C. Allen described the fan motor and riser valve control in a partially air conditioned 40 story building in the December 1933 HPAC. Risers for the vacuum return heating system are controlled by electric steam valves, the cycle being governed by an electric clock system based upon outside temperature, wind direction, sun effect and that important factor, experience.

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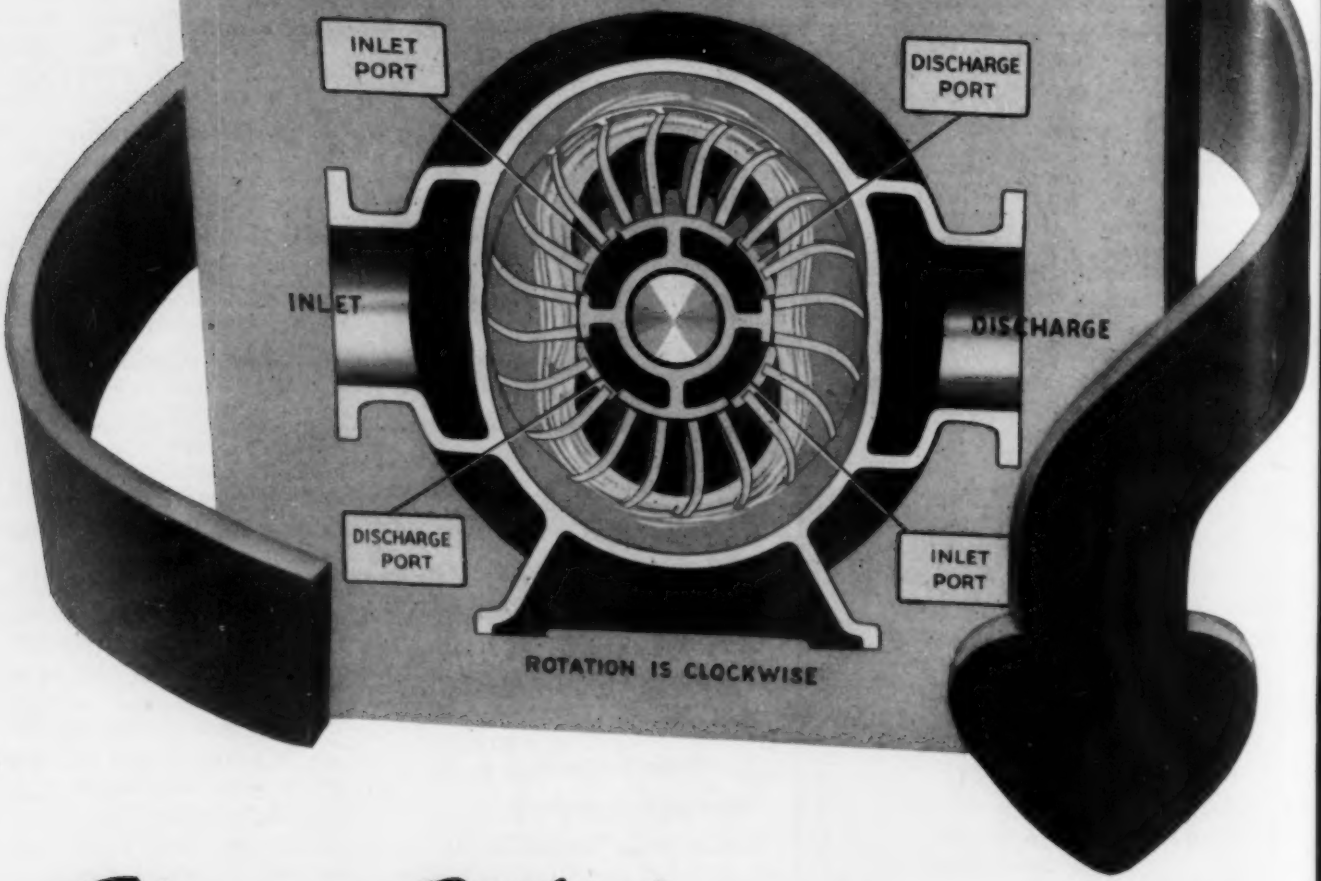

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Data from both radiant h ating

PAUL S. PARK, manager of the engineering service department of A. M. Byers Co., Pittsburgh, draws upon the experiences with 60 snow melting installations which have operated through one or more winters to present this summary of information on design, installation, and operation of a method which has many advantages

How to Design, Install, and Operate

SNOW MELTING SYSTEMS

One of the most interesting and important outgrowths of radiant heating is the use of embedded piping for clearing ice and snow from sidewalks, driveways, roads, loading platforms, and other areas. A study of nearly 100 installations has revealed that this method of melting snow and ice is not only feasible, but practical to the extent that there are decided advantages over other methods now being used. For example, costly labor and removal equipment are eliminated, as is the need for chemicals which usually do not effect complete clearance and are sometimes damaging to surfaces. The hazard of accidents can also be overcome by designing the controls to place the system in operation prior to a snowfall or freezing temperatures.

Besides removing snow, such systems also solve the disposal problem. Water resulting from melted snow evaporates more readily on the warm pavement and is prevented from freezing. On the other hand, shoveling snow merely moves it from one place to another. The snow is still there—either piled up in the gutter to block people alighting from vehicles and preventing motorists from parking, or banked alongside a building. If the snow melts during the day from the heat of the sun, the water usually freezes later and creates an even more hazardous surface. At airports, the problem of high winds blowing snow back on runways after they have been scraped also is common.

Study of 60 Jobs Yields Design Data

The popularity of embedded snow melting systems has resulted in a demand for more information concerning design, installation, and operation procedures. To meet that demand we have completed a survey of 60 installations which have operated through one or more winters and have condensed the data obtained into this report.

In general, snow melting systems can be segregated into three classes:

1) Large areas where the entire surface must be kept clear.

2) Driveways, roads, and similar surfaces where the melting of snow only on wheel tracks will solve the problem.

3) "Localized" melting systems to clear spaces around doorways, railroad frogs and switches, sewer outlets, and similar areas.

One of the first factors to be considered in the design of a snow melting system is the magnitude of

A grid of 1¼ in. pipe on 13½ in. centers was curved to fit this sloping truck ramp at the Bigelow-Sanford Co., Amsterdam, N. Y. The ramp is accessible despite the weather, while nearby streets are covered with ice and snow

peratures of 180 F and higher are

tion will be fully discussed later.

both intermittent hot water and

The 24 ft wide and 600 ft long roadway at the American Cyanamid Co., Bridgeville, Pa., has been quickly cleared of snowfalls up to 12 in. deep

the melting job to be accomplished.

As a general rule, the capacity of the system should be equal to melting snow at a rate of 1 in. per hr. This figure, however, is subject to variation depending on the local snowfall conditions, the judgment of the designer, and the requirements of the owner.

For simplification, however, the calculations which follow are based on a melting rate of 1 in. per hr of snow. Slower or faster melting rates can be obtained by revising the calculations proportionately.

Amount of Heat Required

The amount of heat required to melt snow may be determined by the following formula:

$$H = A\ t\ d\ F$$

where H = Btu; A = area, sq ft; t = thickness of snow, ft; d = density, lb per cu ft; F = latent heat of fusion of snow (or ice), Btu per lb.

Three of the four factors in the above formula can be readily fixed, but the factor d is a variable since the density of snow varies widely, primarily depending on air temperature during snowfall.

In selecting a temperature which would represent an average value at which most snowfall occurs, U. S. Weather Bureau data were consulted. Records of 10 stations, consisting of a total of 27,823 snowfalls over a period of years, revealed that 87.5 percent of all snowfalls occurred in a temperature range of 10 F to 35 F. The mean temperature in this range was 26 F. Consequently, to fix the density of snow at a constant average value for calculations, its density at 26 F will be used.

According to the U. S. Weather Bureau, the average density of snow at 26 F is about 6 lb per cu ft. Using this figure, a melting rate of 1 in. per hr, and a latent heat of fusion of 144 Btu per lb, the amount of heat required per sq ft of area for the melting job only becomes $1 \times (1/12) \times 6 \times 144 = 72$ Btu per hr per sq ft.

Since the Btu per hr obtained by this formula is for melting only, it follows that allowances should be considered for the surface, downward, and edgewise losses. The loss from the surface is extremely difficult to fix with any degree of accuracy. On the assumption that the surface temperature of the snow will closely approach air temperature, it is not considered necessary to make any allowance for loss of this type. For downward and edgewise losses, only estimates can be made.

Past experience suggests an efficiency of 70 percent for such a system. With 72 Btu per hr required for melting, the addition of loss factors results in a total input of about 100 Btu per hr per sq ft of surface to be cleared. Many systems, both in this country and Canada, equipped with boilers and pumps sized on this basis have operated in such a manner as to indicate early empirical data to be accurate within acceptable limits.

Data from both radiant heating systems and snow melting installations indicates that downward and edgewise losses should be considered at 20 percent as a minimum during the melting period. However, since most melting installations are operated intermittently or at low temperatures during periods of no snowfall, an additional allowance of 10 percent is provided for pickup.

The total input required approximates 100 Btu per hr per sq ft per in. of snow, and since both experience and test work have indicated equipment sized on this basis to be adequate it may be considered acceptable for practical design purposes. In sizing boilers or other heating units, the total heat calculated by the use of 100 Btu per hr per sq ft represents only the net boiler output. Standard allowances for pickup and piping losses should be added to obtain the gross output.

Determining Pipe Size and Spacing

With the amount of heat required for the melting job satisfactorily estimated, the next step is the determination of pipe size and spacing. Several years ago, the use of 1¼ in. pipe on 18 in. centers or 1 in. pipe on 15 in. centers was considered an economical design for providing a relatively uniform melting action at the surface. While such spacing obviously results in the melting first occurring immediately above the piping, the lag in the areas between the pipe runs has never been reported to be great enough to be objectionable. These spacings, however, should be considered maximum for the two pipe sizes mentioned. Closer centers can be utilized where more uniform melting is desired. These spacings apply only where the surface is to be completely cleared. Where "track clearance" only is desired, each installation must be considered an individual problem.

Water temperatures for existing snow melting systems have ranged from 110 F upward. Varying degrees of success have been obtained at all levels. One installation was supplied with 180 F water after a snowfall of about ½ in. and rapid melting began within 30 min. All snow was melted approximately 1 hr after the "cold start." Generally, the slower action produced by 110 F water is not desirable, while tem-

has suggested 2½ in. as the minimum thickness of concrete above the piping. This cover is possible

when full expansion joints are planned for concrete, the use of

vantages of the sinuous coil may be listed as lower fabrication cost and

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peratures of 180 F and higher are considered questionable from the standpoint of thermal stress. Consequently, current engineering practice is centered on an average water temperature of 160 F with the temperature drop through the system varying from 10 F to 30 F depending on size and permissible pumping head. The average installation should allow a maximum drop of 20 F, with 10 F being applicable to most residential jobs and 30 F occasionally considered desirable for large systems.

While some industrial applications have utilized steam, this practice is not considered the most desirable for a number of reasons. Except for systems where a continuous flow of waste steam is available, there exists the danger of condensate freezing at the start of a melting operation.

In addition to this disadvantage, the use of intermittently flowing steam presents an expansion problem due to excessive temperature differences when steam is first injected on a cold day. The installation of economical heat exchangers to provide hot water from existing steam lines seems to be the practical solution to offset the drawbacks created by the use of steam in melting lines. Most engineers recognize the undesirable characteristics of steam in this application and thus, with very few exceptions, hot water is the accepted heating medium.

Providing Hot Water for Snow Melting

The majority of installations use a separate boiler, or steam converter, to provide hot water for snow melting. It should be pointed out, however, that in some cases it would be possible to use hot water from the same boiler that is employed for space heating, without overloading. Most heating systems are designed on the basis of 0 F outdoor temperature. Since records show that snow nearly always falls in the 20's, the Btu output not required for space heating could be switched satisfactorily for snow melting. For example, if space heating demands 100,000 Btu output at 0 F, the requirement would be only 65,000 Btu at 25 F. The extra 35,000 Btu then can be utilized for snow melting. The need for antifreeze in the snow melting system must be considered, however, and this question will be fully discussed later.

The question most frequently asked when snow melting installation methods are discussed concerns location of the piping with respect to the surface of the area to be cleared.

Where Should Piping Be Placed?

While faster melting action and a somewhat more efficient system may be obtained with piping near the surface, such practice introduces the problems of concrete fracture and damage to piping from heavy loading. This latter is particularly pertinent where the slab is of asphalt or a similar bituminous material.

The problem of concrete fracture from rapid expansion of the piping is not as readily handled as in the case of radiant heating because with snow melting systems much greater temperature differences are involved—particularly with intermittently operated systems.

Installation records indicate that by far the majority of systems consist of piping placed on top of a prepared fill or base over which the concrete or asphalt is poured. This normally results in the piping being solidly embedded to the extent of 75 percent or more in the slab material. Where a loose stone fill is employed, the concrete may work its way completely around the piping and underneath to a depth of an inch or more. Such systems, both intermittent hot water and continuous steam, have operated under severe weather conditions without visible detriment to the concrete, the asphalt, or the wrought iron pipe used.

Burying pipe in the fill beneath a slab should eliminate all danger of slab fracture, but it also will reduce somewhat the melting action and efficiency. It has been found by observation that a system with piping embedded at the center of a 4 in. slab heated rapidly enough to make the lines of the coils visible 5 min after a cold start beneath a light snowfall. An adjacent system having the piping in sand immediately under the slab did not reveal the lines of the coils for nearly 1 hr.

From both heating and structural standpoints, the disadvantages of installing piping close to the surface or in the fill beneath the slab, weighed against the satisfaction obtained, indicate that piping placed on the fill and covered with concrete or asphalt meets all necessary requirements for an average snow melting system.

What Is the Proper Slab Thickness?

Good concrete practice normally calls for a minimum slab thickness of 4 in. for sidewalks and 5 in. for driveways and other areas subject to light loads. Highways, loading zones, etc., normally require 6 to 8 in. or more. A concrete authority

One of the most widely publicized snow melting jobs is the Best & Co. store in New York City, which has grids of 1¼ in. pipe on 18 in. centers placed on crushed stone beneath a 4 in. concrete slab. It kept the sidewalk clear during the 26 in. snowfall last December; operating cost is reported to be $0.115 per 1000 sq ft per in. of snow

not practical. A compromise be-

Code for Pressure Piping to Be Revised

has suggested 2½ in. as the minimum thickness of concrete above the piping. This cover is possible with pipe sizes up to 2 in. and slab thicknesses not less than 5 in. With a 4 in. slab, the use of 1¼ in. pipe results in a cover of 2.3 in. Decision whether or not to increase the slab thickness or use smaller pipe on closer centers is up to the designer's individual judgment. From a conservative engineering standpoint, it would appear sound to provide a minimum cover of 2½ in., although this figure has not yet been established as a necessary lower limit.

The question of damage to embedded pipe from heavy surface loading can be answered only by experience. In a number of field investigations, it was found that 5 to 10 ton power rollers had been used to level and pack asphalt poured over wrought iron snow melting pipes and no damage occurred. In one case, trucks up to 15 tons gross weight were driven over an asphalt roadway without causing pipe failure. Thus, unless a very unusual loading condition exists, it can be assumed that the possibility of pipe failure from crushing is a remote one.

Expansion Joints in Concrete

Outdoor concrete work normally calls for numerous expansion joints, although structural engineers are reported to be obtaining good results with less joints than normally were specified in the past. However, when full expansion joints are planned for concrete, the use of wrapped expansion loops may be feasible. When a procedure for contraction or constriction joints is involved, the use of pipe wrapping or keyed or doweled slabs may be considered—although it is not a certainty that any special steps of this kind need be taken.

Pipe Grids or Sinuous Coils?

The question of grids versus sinuous coils arises frequently and answers must be based on a number of factors. If the area is very large, it is quite likely that from a hydraulic standpoint grids will be indicated to prevent excessive pump installation and operating costs.

This factor must be evaluated for each individual project, but to give a general idea of the friction heads involved it may be noted that 300 ft of 1¼ in. pipe on 18 in. centers can be used to clear 450 sq ft of surface with a pumping head of about 24 in. This example is based on a heat output of 45,000 Btu per hr and a circulation of 4.5 gpm of water. An allowance of 50 percent is included for bends and fittings, although the resistance of mains, boiler, valves, etc., was omitted. Detailed calculations can be made in much the same manner as for a radiant heating system.

Grids are also easier to pitch for drainage, particularly in areas with sloping surfaces, and this may in some cases be a deciding factor. Advantages of the sinuous coil may be listed as lower fabrication cost and ease of venting, especially with level or nearly level layouts. Regardless of the piping design, drainage and venting are handled according to standard hot water heating practice. The use of compressed air is one means of drainage where gravity flow is uncertain or impossible. Steam systems must also be trapped and vented according to steam heating practice and the system pitched adequately for removal of condensate.

Additional points concerning installation include fabrication by welding to provide durable joints, and avoidance of cinders, slag, and other sulphur bearing materials for fill. Broken stone or gravel are considered the most desirable for this purpose.

Continuous or Intermittent Operation?

One of the major questions is whether to operate a snow melting system continuously or intermittently.

With steam as the heating medium, engineers are of the opinion in most instances that intermittent operation is dangerous because of the possibility of condensate freezing during the starting up period and the danger of excessive expansion of solidly embedded piping.

Continuous steam flow will practically eliminate these disadvantages, but can only be justified from a cost standpoint if waste or exhaust steam is available. Continuously operated steam systems are among the most successful from a melting standpoint since the slab is always well above freezing and snow, even in the case of abnormal snowfalls, never accumulates on the surface.

While continuously operated hot water systems would most closely approach the effectiveness of continuous steam flow, water systems almost always are recirculated systems. Operation of the heater and circulator units is a major cost factor in these. An exception to this rule is one case where a supply of waste steam is utilized to heat water in a converter and circulate it by means of a steam driven pump.

Aside from cases of this kind, it is the consensus of engineers conversant with the subject that continuous circulation of hot water is

At Snake Hill, Belmont, Mass., residents joined together in a snow melting project to keep the road passable at all times. The 1¼ in. pipe is on packed earth, over which the asphalt top was poured

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not practical. A compromise between intermittent and continuous operation would be to maintain moderate heat when snow is predicted, and then to increase the water temperature as snow starts to fall. Heating the drive or runway from a cold start when snow commences obviously requires a longer melting time than does a moderately warm surface.

When it is desired to operate a hot water system only when snow is falling, or has fallen, on the slab surface, the use of a "snow detector" may be practical. This device depends on accumulation of snow on a sensitively balanced metal plate, the depression of which operates an electric switch to energize the pump starter, heater control, or other electrical circuits as desired.

Should Break Water Supply Connection

Up to this point, no mention has been made of the use of antifreeze compounds to prevent the freezing of hot water in a snow melting system. While there are a number of chemicals which can be added to water to produce a low freezing point solution, the most popular appear to be the ethylene glycol base solutions. There are at least two of these available commercially and they have almost identical antifreeze properties.

It should be mentioned that ethylene glycol is toxic and therefore no permanent connection should be made between the snow melting system and water systems which may be a source for human consumption. While an automatic fillup valve used in conjunction with a check valve might prove foolproof, the possibility of valve leakage and backflow into a potable water system makes its sound engineering practice to break the water supply connection after initial use and then manually fill the system with the required amount of antifreeze. With small systems, manual filling with both water and antifreeze is practical.

Both the specific gravity and viscosity of ethylene glycol vary from those of water, but not sufficiently to warrant consideration from any standpoint. There is a greater variation in specific heats, but unless a solution of over 50 percent glycol is used, this variation may also be considered negligible.

Code for Pressure Piping to Be Revised

THE AMERICAN Standard Code for Pressure Piping, safety standard for all steam and power services, is to be completely revised within the next two years, according to Frank S. G. Williams, new chairman of the committee which functions under sponsorship of the American Society of Mechanical Engineers. At an organization meeting attended by representatives of more than 30 cooperating bodies, Mr. Williams, who is eastern manager of the Taylor Forge and Pipe Works, announced plans for bringing the code abreast of current developments in the field of materials, design, and construction.

Originally organized in 1926, the committee includes representatives of groups primarily concerned with safety of high pressure piping systems. Members-at-large are recognized experts in the piping field. Sabin Crocker, mechanical engineer of Ebasco Services, Inc., and a member of HPAC's board of consulting and contributing editors, is vice chairman, and L. W. Benoit of the Manufacturers Standardization Society of the Valve and Fittings Industry is secretary.

In his charge to the committee, Mr. Williams emphasized the character of the code as a safety code rather than a design specification. He stressed the need for making periodic interpretations when necessity arises.

Committee operations will be directed, he explained, by an executive committee composed of chairmen of subcommittees, plus three to five members-at-large. This group would establish policies, supervise and coordinate, arrange publication and distribution of the code, administrate the subcommittee work and maintain liaison with other code making bodies.

Specific subcommittees were appointed to revise sections of the code: (1) power piping systems, (2) gas and air piping systems, (3) oil piping systems, (4) district heating piping systems, (5) refrigeration piping systems, and (6) fabrication.

There are also subcommittess on (1) materials and stresses, (2) standards and identification, (3) instrument piping, (4) mechanical design, (5) liaison with ASME boiler code committee, and (6) welding procedures and qualification.

Thus, the chairman announced, technical subjects which cross all fields of service, such as instrument piping and mechanical design, will be handled by separate technical committees. It is proposed to recognize liaison with other code making bodies as a major function and responsibility to eliminate overlapping of jurisdiction and achieve uniformity. For example, the committee will continue to look to the American Society for Testing Materials for solutions to materials problems. A special committee on welding will keep its attention focused on developments in that field that affect the code.

The ASME boiler code committee already has formed subcommittees to establish allowable stresses for materials. It is proposed to cooperate with this group rather than duplicate the activity.

An editing committee is charged with responsibility for uniformity of style and an indexing system for subject matter in each section of the code under uniform numerical references. This subcommittee also reviews incoming questions dealing with interpretation, makes a canvass of opinion among other subcommittees, and recommends action to the executive committee. Interpretations may then be published as official interpretations of the code.

The chairman recommended that special study be given to the usage and fabrication of the stainless steels, the nickel alloys, and such other materials as aluminum and copper, etc. The physical characteristics and problems of fabrication relating to these materials would appear to warrant a separate section devoted exclusively to them.

The executive committee will meet at six-week intervals until the work is well under way.

All communications regarding the new code should be addressed to the secretary, L. W. Benoit, Manufacturers Standardization Society, 420 Lexington Ave., New York 17, N. Y.

How to Estimate

COOLING TOWER

Performance

TYLER G. HICKS, mechanical designer, Hicks Associates, New York City, *presents information on mechanical draft cooling tower performance for use in preliminary estimates only. The data given have been used by the author and others with success for several years; the values are generally averages from material published by cooling tower manufacturers. . . . Problems of water supply and disposal in many parts of the country point to the ever-increasing usage of cooling towers and evaporative condensers in air conditioning work*

FREQUENTLY—during design work—quick *preliminary* estimates of the area, weight, power requirements, and performance characteristics of a proposed cooling tower are needed. Such estimates can be prepared by the use of simple tables and curves.

Mechanical draft cooling tower size is dependent upon the following factors:

1) Water concentration in tower, gpm per sq ft.
2) Quantity of water to be cooled, gpm.
3) Cooling range, F, $(t_1 - t_2)$.
4) Prevailing wet bulb temperature, F, t_b.
5) Wet bulb approach, F, $(t_2 - t_b)$.
6) Time of contact between air and water, or tower height.
7) Air velocity in cooling tower.
8) Quantity of air provided per unit volume of water.

The influence of those factors which are of importance in preliminary estimates will be illustrated by several problems.

Assume that an induced draft cooling tower for refrigeration service is to handle 1400 gpm; water temperature on tower, t_1, will be 92 F, water off tower, t_2, 82 F. The prevailing wet bulb temperature, t_b, is 75 F. Determine the tower size and performance characteristics.

Performance Calculations

Tower area is primarily a function of the water concentration, gpm per sq ft, in the tower. Extensive experience has indicated that for a tower of given area, good performance is obtained when the water concentration is in the range of 2 to 3.5 gpm per sq ft. Hence, in most cases, it is well to adhere to water concentrations in this range. Typical concentration values, water on, water off, and wet bulb temperatures for induced draft towers are shown in Table 1. These figures represent average values for a large number of towers in use today. By use of these or similar plotted data, the minimum tower area can be determined.

Entering Table 1 at 75 F wet bulb, and a 10 deg cooling range (92 — 82), it is found that a water concentration of 3.0 gpm per sq ft is required when the on and off temperatures are 92 and 82 F respectively. Since 1400 gpm will be handled, the minimum tower area will be 1400 ÷ 3, or 467 sq ft.

From Table 2, with an approach to the wet bulb of 7 F (82 — 75) and a cooling range of 10 F, the minimum tower height is found to be 30 ft. From Table 3, with 1400 gpm cooled, the installed weight of the tower is 63,000 lb. Checking the height with that obtained from Table 2, the value is seen to be approximately the same, or 31 ft. From Fig. 1, with 1400 gpm cooled, a 25 hp motor is required.

Thus, in a matter of a few minutes, *approximate* values suitable for *preliminary* estimating purposes have been obtained for this tower. From the structural standpoint the tower will require at least 467 sq ft of floor or roof area, will be about 40 ft high after allowances are

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Table 1—Typical cooling ranges and water concentrations for induced draft towers

Wet bulb temp. F, t_b	Cooling Range, F: 10 — Water on tower t_1	10 — Water off tower t_o	10 — Gpm per sq ft	20 — Water on tower t_1	20 — Water off tower t_o	20 — Gpm per sq ft	30 — Water on tower t_1	30 — Water off tower t_o	30 — Gpm per sq ft	40 — Water on tower t_1	40 — Water off tower t_o	40 — Gpm per sq ft
60	70	60	1.25	85	65	1.5	95	65	1.25	108	68	1.25
	75	65	2.0	90	70	2.0	100	70	1.75	110	70	1.5
	80	70	3.1	95	75	2.9	105	75	2.3	120	80	2.3
	95	85	4.0	100	80	3.3	110	80	2.8	130	90	3.2
65	77	67	1.5	90	70	1.5	100	70	1.25	112	72	1.25
	80	70	2.0	95	75	2.4	105	75	1.75	120	80	2.0
	82	72	2.5	100	80	3.0	110	80	2.5	125	85	2.5
	85	75	3.0	105	85	3.4	120	90	3.3	135	95	3.3
70	80	70	1.25	92	72	1.25	105	75	1.35	120	80	1.75
	83	73	2.0	95	75	1.75	110	80	2.0	125	85	2.4
	85	75	2.5	100	80	2.5	115	85	2.8	130	90	3.0
	90	80	3.5	105	85	3.0	120	90	3.3	140	100	3.6
75	86	76	1.25	97	77	1.25	110	80	1.5	120	80	1.4
	89	79	2.5	100	80	1.75	115	85	2.3	125	85	2.0
	92	82	3.0	105	85	2.5	120	90	3.0	130	90	2.5
	95	85	3.5	110	90	3.3	125	95	3.3	140	100	3.5
80	90	80	1.25	102	82	1.25	112	82	1.25	122	82	1.25
	94	84	2.5	104	84	1.75	115	85	1.75	126	86	1.75
	100	90	3.5	110	90	3.0	120	90	2.4	130	90	2.3
	102	92	4.0	115	95	3.5	125	95	3.3	135	95	3.0

made for piping and auxiliary apparatus, and will weigh about 63,000 lb. With this information, the size, spacing, and number of supports needed for the tower can be readily computed.

From the mechanical standpoint the tower will require piping of suitable size to handle 1400 gpm, will need a pump to handle this water at the given temperatures, and must be fitted with suitable drain piping. Electrically, a power supply for the 25 hp tower motor and for the pump motor will be required. The rating of the latter will depend, of course, on the heads encountered in the particular installation. It should be most carefully noted that the data presented are for a particular tower and that performance will vary from one manufacturer to another.

Fig. 2 shows fan power requirements for towers cooling more than 1400 gpm.

Performance Calculations for New Conditions

The above problem shows the general method for a proposed installation. A second problem which is encountered in general design work is the application of an existing tower to new conditions. Since this is simply another phase of the general performance problem it can be treated in a similar manner. A typical problem will illustrate the method of handling.

An existing induced draft tower was designed to handle 375 gpm through a 40 F range, 130 F to 90 F, at a prevailing wet bulb of 75 F. What will be the effect on performance if the prevailing wet bulb changes to 65 F?

From Table 1, with a 75 F wet bulb, a 40 deg cooling range (130 — 90), the water concentration is seen to be 2.5 gpm per sq ft. Decrease in the wet bulb will not affect the water concentration on the tower because the water flow rate and tower area remain constant. Hence, running up Table 1 to a 65 F wet bulb, read opposite 2.5 gpm per sq ft, water on 125 F, and water off tower 85 F. Therefore, the cold water temperature will decrease to 85 F when the prevailing wet bulb falls to 65 F.

Now suppose that an increase in the amount of water to be cooled is necessary; say from the design conditions of 375 gpm to 500 gpm. The tower area remains constant; 375 gpm divided by 2.5 gpm per sq ft is 150 sq ft. With a design wet bulb of 75 F, the heat load on the tower was 375 × 8.33 × (130 — 90) or 125,000 Btu per min. This is the maximum heat load that can safely be assumed for the tower at the design wet bulb.

With 500 gpm flowing, the range is 125,000 divided by (500 × 8.33), or 30 F. Referring to Table 1, 75 F wet bulb, 30 F range, and 500 gpm per 150 sq ft or 3.3 gpm per sq ft concentration, the on temperature is found to be 125 F, off 95 F. Therefore, the cold water temperature would rise 5 F over the design conditions stated above.

Table 2—Induced draft tower heights

Approach to wet bulb, F ($t_o - t_b$)	Cooling range F ($t_1 - t_o$)	Approximate tower height, ft
Less than 4	20 — 40	35 — 40
5 — 8	25 — 40	40
	10 — 25	30 — 40
8 — 15	25 — 40	30
15 — 20	25 — 40	20

Number of Nozzles Required

Another problem which frequently arises in cooling tower work is the number of nozzles which will be required in the tower. Fig. 3 shows the capacities of various size nozzles which are widely used in cooling towers. For the existing tower discussed above, with a water pressure of 10 psi, 1 in. involute nozzles, and 500 gpm flowing, approximately 50 nozzles would be required. Using the curves or similar data, the most suitable water pressure and approximate number of nozzles can readily be determined.

How Much Make-Up Needed?

In regions where water is scarce (and hence expensive) make-up water requirements may be of importance. In any cooling tower, the process which takes place results from evaporation of a portion of the water passing through the tower and from an exchange of heat between the water and air. Under normal conditions, about 85 percent of the cooling is done by evap-

Table 3—Induced draft tower weights and heights

Gpm cooled	Net weight of tower lb	Approx. weight of water, lb	Total installed weight, lb	Height of tower, ft
40	1,000	500	1,500	7
100	3,000	1,500	4,500	9
250	10,000	3,500	13,500	20
375	13,000	4,500	17,500	20
550	16,500	6,500	23,000	24
850	24,000	11,000	35,000	25
1,100	35,000	14,000	49,000	27
1,400	44,000	19,000	63,000	31

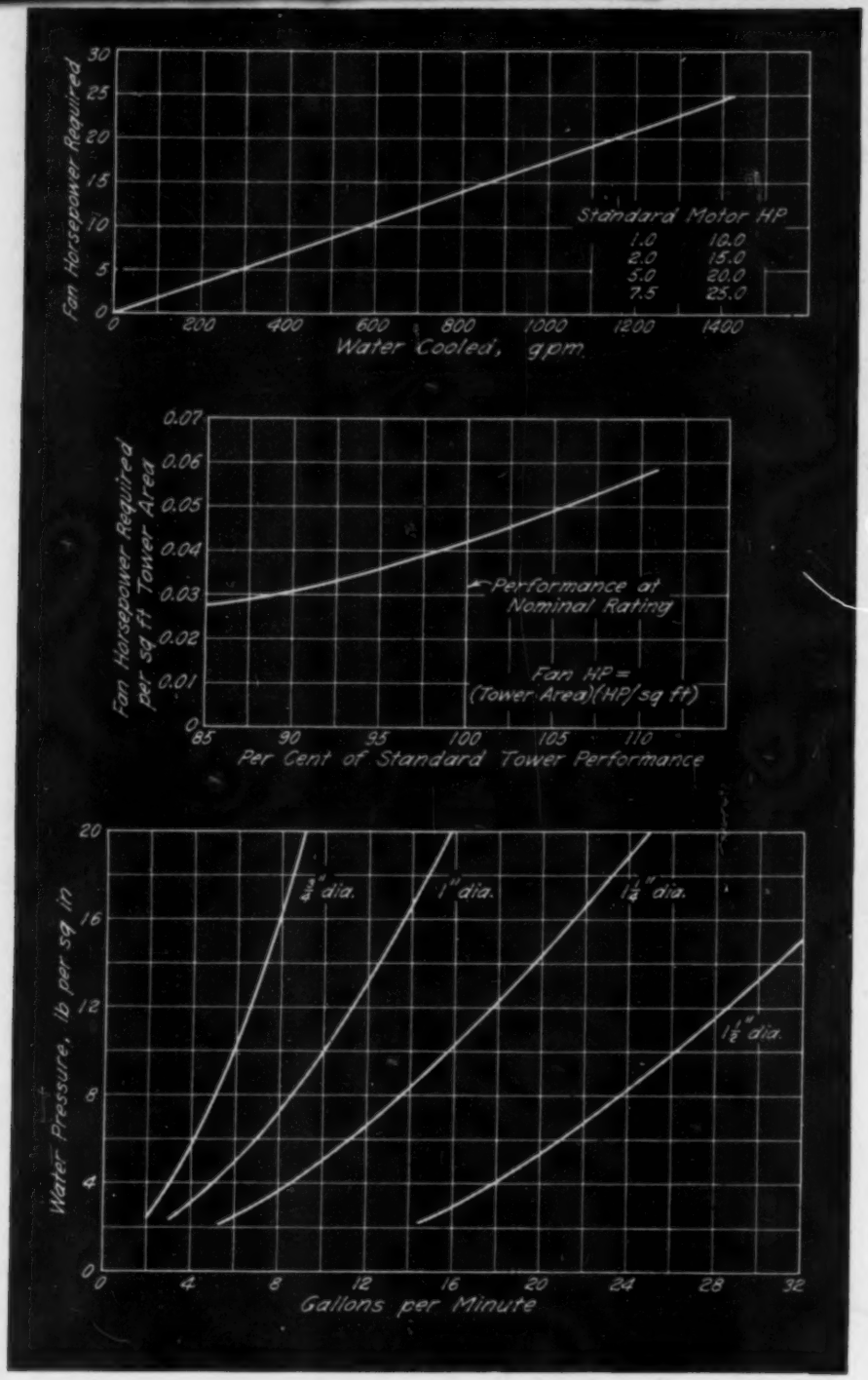

Fig. 1 (top)—Data on fan power requirements for mechanical draft cooling towers, (for use in *preliminary* estimations.) Fig. 2 (center)—Fan power requirements for mechanical draft cooling towers with capacity of 1400 gpm or more (for use in *preliminary* estimations). Fig. 3 (bottom)—Capacities of involute type spray nozzles for cooling tower work (for use in *preliminary* estimations.)

oration and 15 percent by heating the air. When maximum summer conditions prevail, all the cooling will result from evaporation because the water will often enter the tower at a temperature less than the prevailing dry bulb. Make-up water requirements are generally based on maximum summer conditions. In equation form the make-up is

$$Q = \frac{(t_1 - t_o)\ \text{gpm}\ (8.33)}{1000}$$

where Q = quantity of water evaporated, lb per min, or make-up required; t_1 = temperature of water on tower, F; t_o = temperature of water off tower, F; gpm = water cooled, gpm; 1000 = Btu required to evaporate 1 lb of water.

There will also be a small loss resulting from water being carried off by the wind. This is known as windage loss and seldom exceeds 0.2 percent of the water cooled.

In general air conditioning design work, the designer cannot investigate a proposed tower much beyond the outline given in this article. More detailed performance data can come only from the builder of the tower after proposed operating conditions have been thoroughly studied. However, the method of analysis presented is believed to be sufficiently accurate for preliminary estimates.

ECONOMISTS EXPECT MILD CHANGES IN TRENDS

A consensus of opinion among 112 leading economists polled by F. W. Dodge Corp. indicates moderate adjustments and only mild changes in current economic trends during the coming year. The group polled includes economists in business corporations, financial institutions, universities, and economic research organizations.

Sixty-four economists anticipate a business recession in 1949. Fifty-one of them characterized the expected setback as mild, 10 as moderately serious; only three expected a recession of serious proportions of extended duration. A quite considerable minority, numbering 47, expects no recession at all in 1949. More than 70 percent of those who do expect a recession think it will start before the middle of 1949; some thought it had already started.

A number of those replying made reservations to the effect that all estimates would become invalid in case of war.

With respect to residential building volume, 67 expect a decrease next year, 28 expect an increase, and 13 expect approximately the same number of family units will be built as in 1948. A majority of 76 anticipate declining dollar volume of private nonresidential construction, 25 expect an increase, and six expect the same volume as 1948. Public construction volume is expected to increase by 70 respondents, to decrease by 24, and to hold steady at 1948 levels by eight.

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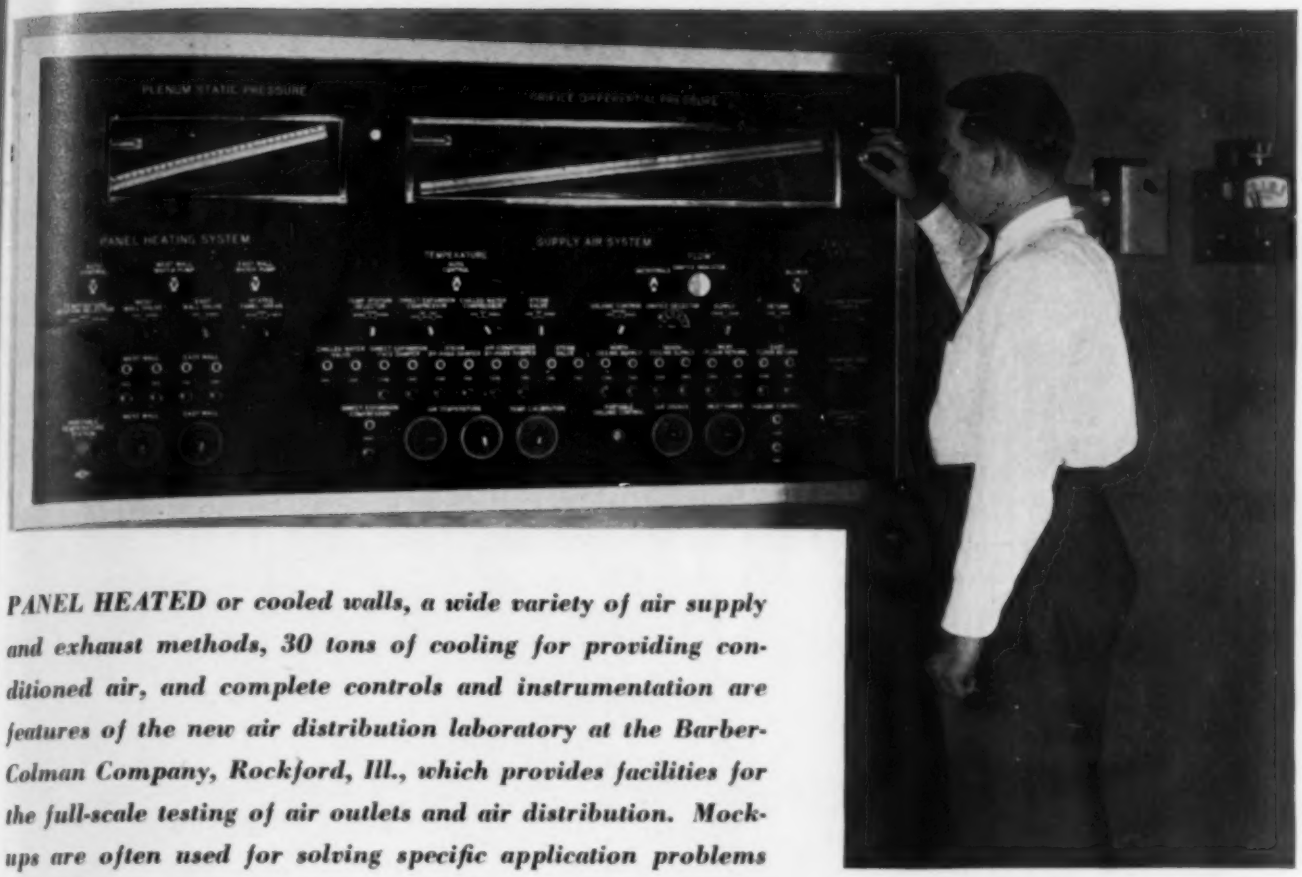

***PANEL HEATED** or cooled walls, a wide variety of air supply and exhaust methods, 30 tons of cooling for providing conditioned air, and complete controls and instrumentation are features of the new air distribution laboratory at the Barber-Colman Company, Rockford, Ill., which provides facilities for the full-scale testing of air outlets and air distribution. Mock-ups are often used for solving specific application problems*

New Air Distribution Lab *Controls Test Variables*

FLEXIBILITY is the important factor that must be provided in a laboratory for the study of air distribution, according to Walter Kennedy, director of the big new air distribution lab at the Barber-Colman Company, Rockford, Ill., for here are at least 14 factors which must be considered as variables in the rating and testing of a grille or air diffuser.

The factors involved are face velocity, air volume, noise, aspect ratio, grille type and fin arrangement, grille mounting height, distance of grille from ceiling, length of room (throw), temperature differential, width of room, temperature of walls (especially the wall opposite the grille), location of return grille, type of ceiling (smooth, rough, or beamed), and obstructions (such as columns, light fixtures, furniture, etc.).

Air distribution laboratory facilities for the control of these—and other—variables must also permit full-scale tests, according to Mr. Kennedy. While facilities of this kind represent a substantial investment, the cost is justified because of the importance of accurate test and rating data for grilles and diffusers, the development of new products, and the opportunity afforded for studying different schemes of air distribution with full-size mockups. For example, mockups of office areas, ship staterooms, railroad car spaces, aircraft cabins, telephone exchanges and similar spaces have been constructed, air has been introduced and exhausted by various methods, and the most suitable has been determined in advance of actual building. The air distribution problem of one telephone exchange was particularly difficult because of the obstructions to air flow in the space due to the vast amount of equip-

This construction view shows the pipe coils for the panel heating and cooling for the east and west walls of the main test space. The metal wall panels, to be ⅞ in. from the pipes, have not yet been installed

ment; studies of the mockup permitted a scheme to be evolved that would distribute the required air quantity without the drafts which would be uncomfortable to the personnel.

Main Test Area Is 100 by 50 Ft

The main test facility of the new laboratory has a length of 100 ft, a width of 50 ft, and a height of 21 ft. An acoustical ceiling is suspended 15 ft above the floor, leaving a 6 ft space for access or modifications to the ductwork when this may be necessary for various tests. When data are required for outlet performance at lower ceiling heights, a false ceiling is suspended at the desired height.

Fluorescent light troughs, recessed in the acoustical material so they won't obstruct air flow, run the full length of the ceiling and provide 30 foot-candles of illumination at the working level. Removable panels are strategically located throughout the ceiling for the installation of ceiling outlets to conform to different design and application problems. The center portion of one 50 ft wall is divided into removable panels of various sizes to accommodate different sized grilles and permit their installation at various heights. Behind this center portion is a plenum supplied by the air conditioning system. Movable partitions can be erected and adjusted within the main test space.

Continuous smoke generating equipment is provided for observation of the progress of tests. Titanium tetrachloride is used for spot checking, and ammonia and anhydrous hydrochloric acid gas is used for testing. The laboratory can be made absolutely dense with smoke in a matter of a few minutes and yet still can be worked in. The smoke paterns are recorded by still or motion picture camera equipment. Photographic record is not only valuable in application demonstrations but is essential to the successful development of new equipment. Permanent visual record of a unit's performance charts the orderly progress of the design and assures production of a unit completely engineered and tested for its end use. Glass panels are set into the wall to permit observation of tests from an adjoining corridor.

Panel Heated or Cooled Walls for Test Area

Perhaps the most unusual feature of the main test space is the system of panel heating and cooling, the design and function of which are both unique in many ways. A basic purpose of this system is to make available peak loads throughout the year without introducing uncontrolled variables. Heating equipment in, and projection of air streams into, the test space is avoided because either would influence air distribution characteristics of equipment under test.

For flexibility in control and rapid change of conditions maintained, the panel system—installed on the two long (east and west) walls of the main test space, each wall being 100 ft long and 15 ft high—is of thermally light construction. Prefabricated aluminum sections, each of which is 2½ ft by 5 ft, make

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up these two big walls. The backs of these metal panels are painted flat black to promote transfer of heat by radiation from or to the grids of ¾ in. pipe; there is ⅞ in. of air space between the pipes and the backs of the metal wall panels.

On the other side of the pipes is placed aluminum foil insulation, the pipes being fastened to the 6 in. joists which are on 16 in. centers. Space between the joists is filled with 2 in. of balsam wool insulation, and on the outside of the joists is, of course, the brick wall. Thus, both balsam wool and aluminum foil insulation on the exterior side of the piping system resist heat loss, and the flat black of the backs of the aluminum wall panels promotes heat transfer both by radiation from or to the pipe, in addition to conduction from or to the air space and the wall panels.

The ¾ in. pipes behind the metal wall panels are on 5 in. centers. For flexibility of control, the pipe layout for each long wall is divided into two halves (front and rear), each half is divided into two sections, and each of these two sections has three vertical subdivisions. Either warmed water or chilled water may be supplied to the piping system.

Square head cocks for each section of the piping provide for balancing, which is accomplished quite easily by putting thermocouples on the interior wall surfaces. The panel heating system supplies 100 Btu per hr per sq ft, a total of 300,000 Btu per hr.

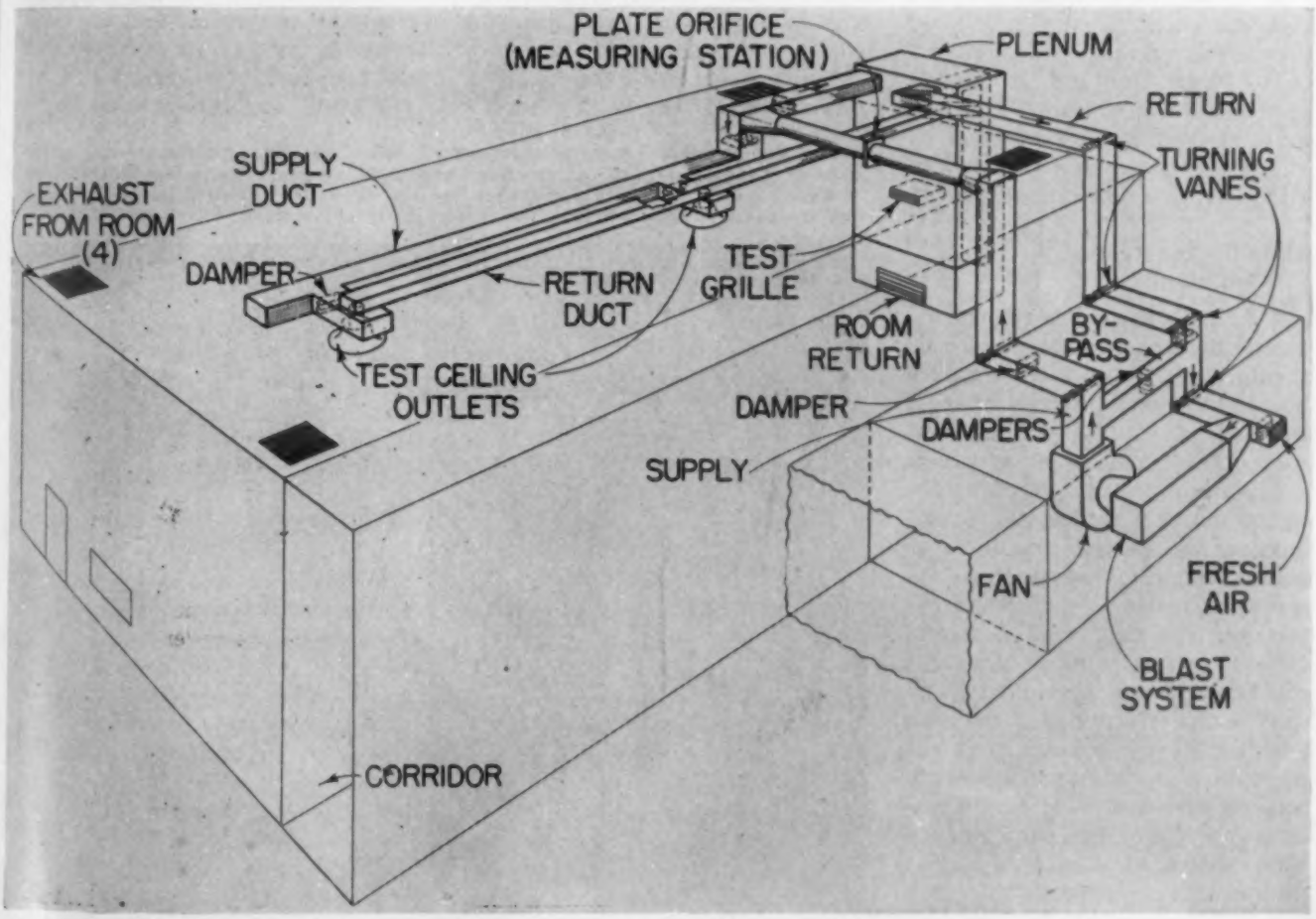
Because one of the panel system walls is an exterior one and the other is interior, it is particularly important—for uniformity of conditions in the test space—to balance them thermally. This is accomplished by a temperature sensitive element mounted on each of the two walls and temperature control bridge circuits which control three way valves to keep the interior surface temperatures of each of the walls equal. However, a temperature differential can be maintained manually.

This type of wall construction was adopted after extensive tests of other methods to permit flexibility in changing test conditions rapidly. If one of the 2½ by 5 ft panels should be damaged for any reason, it can be easily and quickly replaced. In a preliminary study of a panel heating construction using pipe embedded in plaster, it was found that the pipe expanded more rapidly than the plaster and caused cracks with a rapid change from heating to cooling (210 F water temperature to 50 F water temperature in a period of 10 min). This, of course, is a temperature change that wouldn't be encountered in comfort heating work, but must be provided for in a laboratory of this kind where a test of air distribution equipment under heating conditions may follow a cooling test.

The metal panel wall construction used for this laboratory system has already attracted interest in connection with other possible uses. One consideration is its possible application in general office areas, installed as a strip along exterior walls under the windows.

To conclude this description of the walls of the main test space, it should be mentioned that the interiors are painted in two shades of green in order to simulate a 5 ft high occupancy zone. This provides an easy method of indicating the heights of air streams.

The scheme of air distribution used for the test space, which is under complete control from the central panel



Outlets are provided in the ceiling of the test area for use when investigating performance of ceiling type diffusers. The fluorescent lighting is flush with the acoustic ceiling so as not to obstruct air flow

In addition to providing the correct conditions in the main test area, air in quantities ranging from 50 to 12,000 cfm and at a wide variety of temperature conditions must be available to introduce to the test area through the air distribution product being investigated.

12,000 Cfm Against 5 In. Static

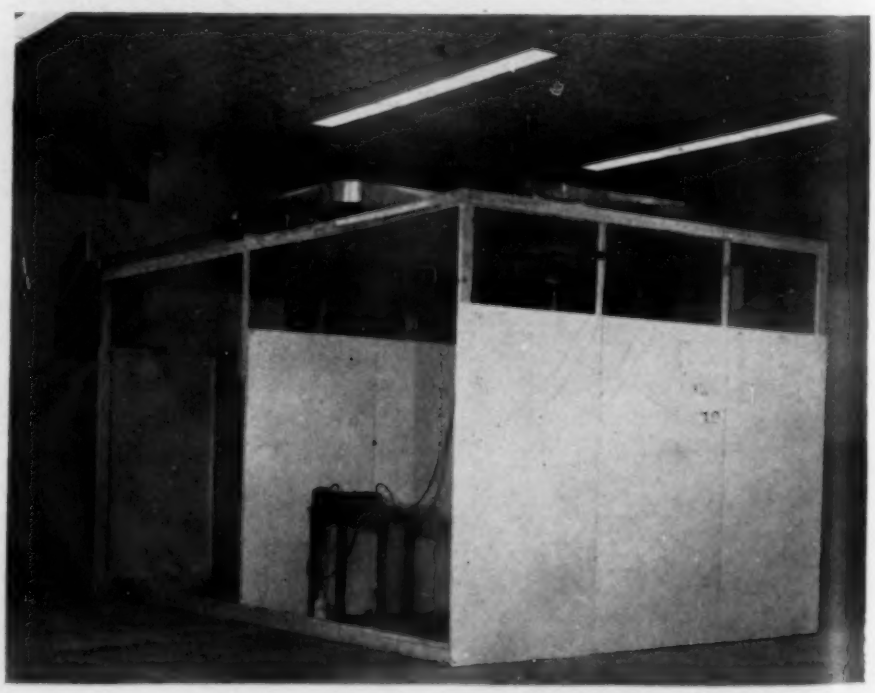
The chief components of mechanical equipment for the air conditioning and heating system are housed in a special equipment room which is isolated from the main test space. This main supply system is a builtup unit with a carefully designed multiple bypass system and a unique volume metering device to permit efficient operation of the system at reduced volumes and capacities. The unit contains steam, direct expansion, and chilled water coil banks, steam humidifiers, and filter banks. The design of the unit, selection of components, and coordination of automatic electric controls are such as to permit operation of the system throughout a wide range of air supply volumes to the maximum of 12,000 cfm and against static pressures up to 5 in. The cooling system is designed for continuous loads up to 30 tons, providing temperature differentials as high as 40 F (depending on air quantity and relative humidity) with uniform control of the system when operating at reduced capacities.

The direct expansion and the chilled water systems each have 15 tons capacity and each is entirely separate from the other. The combination of direct expansion coils and chilled water coils gives accurate regulation of discharge temperatures—an important factor when testing air distribution units for operation at maximum temperature differentials for economy in duct and outlet sizing. Besides the air conditioning unit and compressors, the equipment room contains the water chilling unit, chilled water storage tank, circulating pumps, heat exchanger (supplied with 40 psi plant steam) for the panel hot water supply, and electrical, control, and accessory equipment.

Air Introduced to Insulated Plenum Chamber

The conditioned air is introduced into a heavily insulated plenum chamber 21 ft high, 14 ft wide, and 8 ft deep which is back of one end wall (the north wall) of the main test space. Reinforced panels of ¾ in. plywood separate this chamber from the test space, and are gasketed to prevent air leakage with the high pressures sometimes used. The grilles and outlets to be tested

Full-scale mockups—such as this one of office building partitions—are often used in studying methods of air distribution. This picture was taken in the main test area toward the plenum chamber end and shows the plywood panels in which grilles are installed, as well as the return grille at the floor.



Controlling Airborne Wastes

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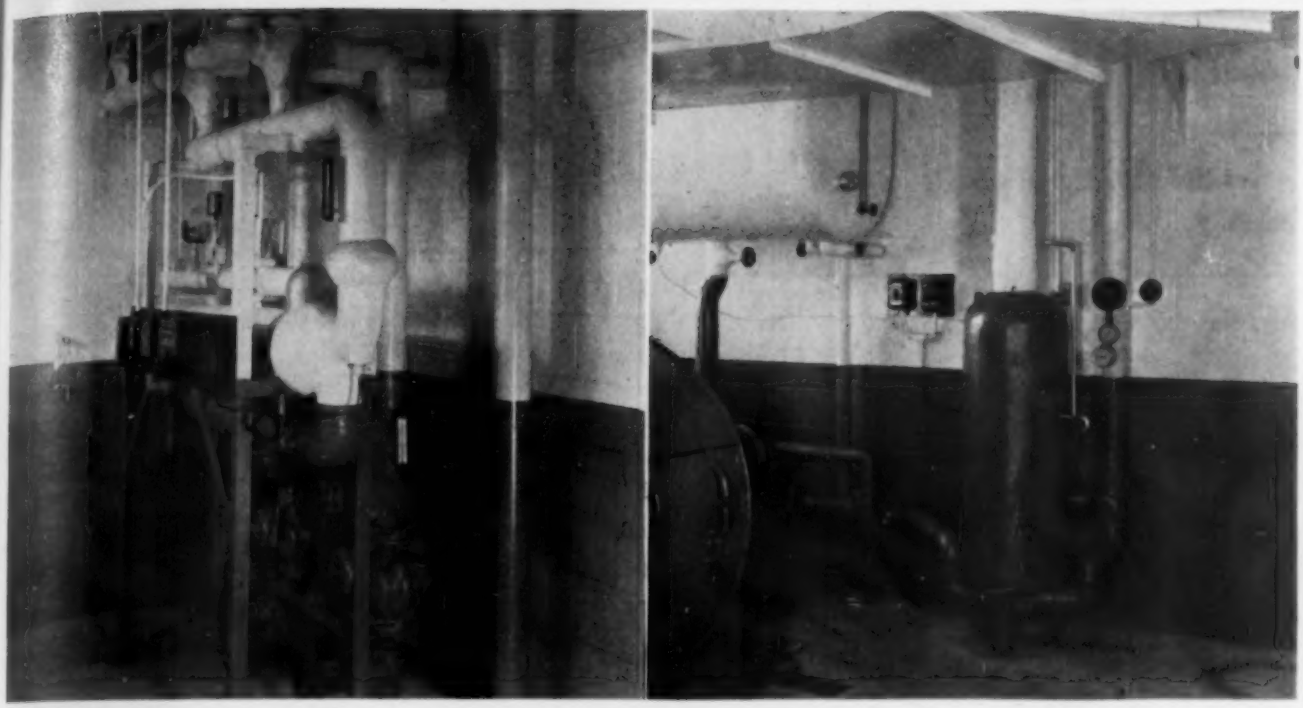

Left—Among the apparatus in the heating and air conditioning equipment room is a heat exchanger supplied with 40 psi plant steam for furnishing warm water to the wall heating coils of the main test area. Right—There is a chilled water storage tank in the equipment room for the water coils in order to provide a "bank" of cooling effect

are mounted in these panels, which can be placed at different heights and in various positions—again offering the flexibility which is essential in a laboratory of this kind. An approach duct protrudes back into the plenum chamber from the plywood panel in which the test grille is mounted, so that the vena contracta will not affect the grille's performance.

There is a 4 sq ft grille in the ceiling at each corner of the main test area to exhaust smoke and room air to the atmosphere rapidly; air is returned to the system through a grille at the plenum chamber end of the test area. Two main outlets are provided on the centerline of the ceiling of the main test area for mounting ceiling type air diffusers for testing, with provisions for other outlets as desired.

Complete Control from Central Panel Board

A central control station is installed in one corner of the main test space to permit alboratory personnel to change test conditions without leaving the space. The control panel incorporates remote control of temperature and humidity of the air supply, temperature of the wall panels, volume and velocity of the air supply, proportions of return, exhaust, and outdoor air in the system, the method by which air is exhausted, and other adjustments possible through remote positioning of damper controllers and valves, and temperature and humidity settings. In addition to this control panel, the central control station incorporates the instruments to indicate and/or record test data. This instrumentation, plus the construction of the test space, insures accuracy in recording the important factors of noise level, air flow, and temperature. The compilation of such data is an essential supplement to photographic and written records of a test, and the central control station provides every facility for this purpose.

Air quantity is controlled from the panel board (and is indicated thereon) by an orifice in the 30 in. round main supply duct in the attic space which has a motor operated metering valve. Limit switches govern the position of this valve, and its position is indicated graphically on the panel board.

The panel board is also equipped with the necessary controls to prevent freezing in the attic space over weekends and on holidays.

This new air distribution laboratory was built on the roof of an existing building, a plastic type floor being poured to equalize the level. The laboratory facilities include a workshop for the assembly and minor modifications of study models, storage space for test equipment and units awaiting test, plus offices and drafting space. The director of the laboratory and his staff have access under this plan not only to necessary test facilities and equipment but find everything grouped for maximum efficiency and minimum delay in the progress of their work.

Conference and lecture rooms are included with facilities for motion pictures, slide projection, and other visual aids. The films which trace and help in the development of equipment also provide material for discussion and instruction in these conference rooms.

It is believed that this new air distribution laboratory will, through the flexibility of the design, permit rapid advance in the science of engineered air distribution. It is planned to offer inspection trips through the new laboratory to interested groups and to engineers to whom problems of air distribution are of paramount importance.

The special Show Section in next month's HPAC will give complete information on the International Heating, Ventilating, and Air Conditioning Exposition to be held in Chicago, January 24-28.

helmet, providing 6 cfm of clean, washed air, has been devised which

exhaust ventilation—or at least exhaust stacks—on furnaces and

standards for acceptable discharge rates for industrial atmospheric

Controlling Airborne Wastes From Porcelain Enameling

HUBERT S. KLINE, industrial hygiene engineer, Frigidaire Div., General Motors Corp., classifies airborne wastes inside and outside the plant, tells why they present problems that must be solved, and suggests methods for doing so. His remarks have been taken from a paper covering both liquid and airborne wastes that he prepared for a Porcelain Enamel Institute forum

AIRBORNE WASTES from porcelain enameling plants may be losses of valuable materials, as well as obnoxious vapors and gases, which escape into the air inside of the plant or are transported outside of the plant by exhaust systems. The first classification of such losses, (those airborne inside of the plant) become the problem for the industrial hygiene engineer. When such airborne materials are transported from the plant through exhaust systems in large amounts they become a problem for the plant engineer, process department, or the chemical laboratory. When do these airborne wastes become a problem? At this point, let us divide the subject matter for further consideration.

Airborne Wastes Inside the Plant

Porcelain enameling processes create airborne wastes which can be considered detrimental to the working environment inside of the plant. These wastes may be dusts, mists or vapors, and gases. "Industrial hygiene" may be defined as the combined effort of engineering, chemistry, physics, and medical sciences to maintain the working environment free of harmful substances capable of causing occupational diseases. The average human can withstand the toxic effects of many known poisons for varying lengths of time without injury. Accordingly, many states and agencies of the federal government have established limits of exposure for a large number of airborne substances found in most industries. These are recorded as maximum allowable concentrations (MAC) of chemicals permitted for safe inhalation or exposure during an 8 hr working day. An average list of MAC limits for the enameling industry would include those shown in the accompanying tabulation.

With a knowledge of these limits, the industrial hygiene engineer is in a position to evaluate the hazards of the working environment and to recommend a satisfactory solution. It should be kept in mind that it is very often necessary to spend money to save money. Workers in some industries are being exposed needlessly to toxic atmospheres which, in due course of time, will render them unfit for further work. This may require payment of compensation in seemingly large amounts, but actually far less than the person's productive worth. State compensation groups, the legislatures, and labor organizations are cognizant of these facts and industry must show a proper attitude toward maintaining a healthy work place in the shop.

Health Problems and Probable Solutions

Dusts in Air—A common source of dust in the enameling process is the mixing of the enamel materials in the mill room. Handling of bags of frit, clay, and other dry ingredients in preparing the additions for the enamel slip can create very high dust counts in the breathing zones of workers so employed. From information at hand, it is evident that enameling dusts do not contain high concentrations of free silica (SiO_2). Nevertheless, the plant manager and his staff cannot overlook the fact that there is a potential hazard that can result from inhaling small amounts of free silica over long periods of time. From the accompanying table, we find that silica bearing dusts are limited to a definite number of particles per cubic foot of air allowed for inhalation in a scheduled 8 hr working day. To avoid compensation and legal claims resulting from questionable exposure, it is well for the management to consider installing exhaust ventilation equipment or to provide approved respirators for mill room employees who handle dusty material.

Spraying of enameling slip can also be the cause of high dust exposure to the sprayer. This is particularly true when the operator is spraying into a cabinet or concave surface which allows the material to bounce back into his breathing zone. For this reason, it is well to do all spraying work in exhaust ventilated spray booths. An ingenious air line

Maximum allowable concentration (MAC) limits for porcelain enameling industry

Substance	Maximum allowable concentration *ppm*	*mg/m³*	*mppcf*
Benzene (benzol)	100		
Benzine (naphtha, Stoddard solvent)	1000		
Carbon monoxide	100		
Carbon tetrachloride	100		
Chromic acid		0.1	
Chlorine	1		
Fluoride dusts, smokes		1.0	
Hydrochloric acid	10		
Hydrogen cyanide	20		
Hydrogen fluoride	3		
Nuisance dusts			50
Silica (quartz, free silica)			5
Sulfuric acid		5	

Note: ppm or parts per million parts of air.
mg/m³ or milligrams per cubic meter of air.
mppcf or millions of particles per cubic foot of air.

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helmet, providing 6 cfm of clean, washed air, has been devised which the operator can wear at all times while spraying. This helmet protects him from inhaling any of the dusts resulting from the spraying process.

Another source of dust in the porcelain enameling plant is the brushing of enamel from the edges or surfaces of ware coming from the drying ovens. It is common to see employees wearing cotton gloves wiping off the dryed enamel dust and then clapping their hands to remove the dust from the gloves. In many cases portable revolving brushes are used and in other instances hand brushes are used at elevations above the worker's head, which allows dust to fall into his breathing zone. Here again it is recommended that well designed exhaust systems be installed or that approved respiratory equipment be provided.

Mist and Vapors—Cleaning of the ware prior to enameling can cause mist or vapor to be created in the plant atmosphere. For these reasons, all toxic materials and heated tanks of nontoxic material in the pickle layout should be exhaust ventilated. If there is any doubt regarding the need for exhaust ventilation, acid and alkali vapors when inhaled will dispel the doubt. These materials cause severe irritations of the membranes of the nose and throat and also irritate the eyes. Heated tanks of liquid which cause steaming are generally ventilated in order that humidity in the plant can be controlled at a satisfactory low level.

Gases—An occasional source of complaint is the gases from drying ovens in connection with pickling and firing of enamel ware. Gas fired ovens can be a source of carbon monoxide as well as irritating combustion products of the burned and unburned gas. Another source of complaint is from the gases arising from the furnaces. Fluoride bearing enamels can be the cause of irritating fluorine gases. This complaint is noticed usually by maintenance workers required to service conveyor lines running through the furnaces. Such gases are toxic in low concentration and cause severe irritation of the respiratory system and the eyes. For these reasons, it is well to provide exhaust ventilation—or at least exhaust stacks—on furnaces and ovens.

Airborne Wastes Outside the Plant

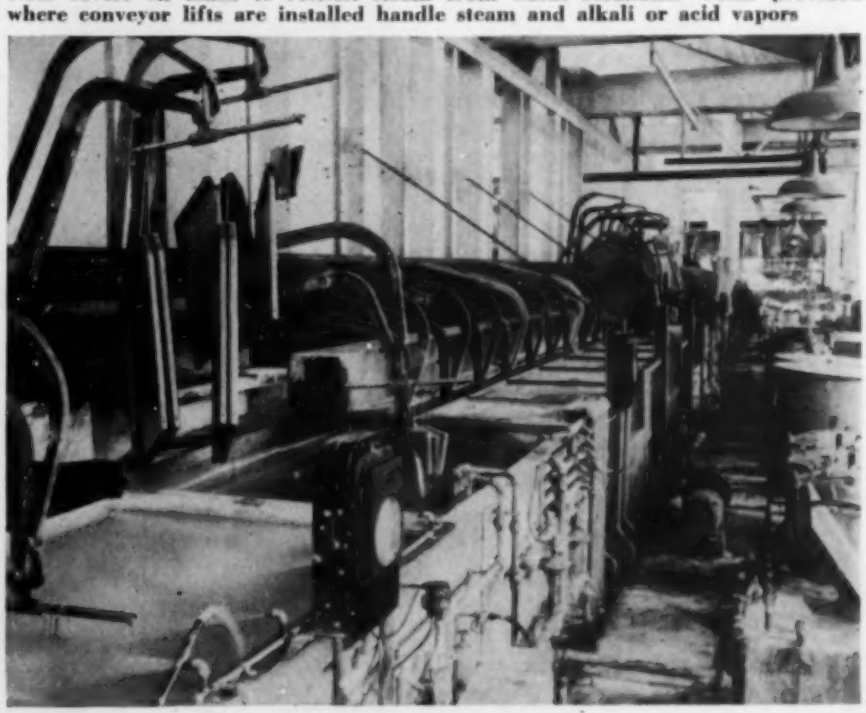
Atmospheric contamination by trade wastes has passed the "matter of fact" stage and is entering the "matter for concern" area. Mounting public opinion is beginning to crystallize and rain down upon managements whose plants are the worst offenders. For many years, only those industries whose airborne wastes were toxic to persons and vegetation in neighboring communities have been required to take necessary control procedures. Today, the finger is pointed toward all manufacturers and others who create neighborhood nuisances, either in the form of odors, dusts, mists, fogs, or smokes. We must evaluate the problems in this new light.

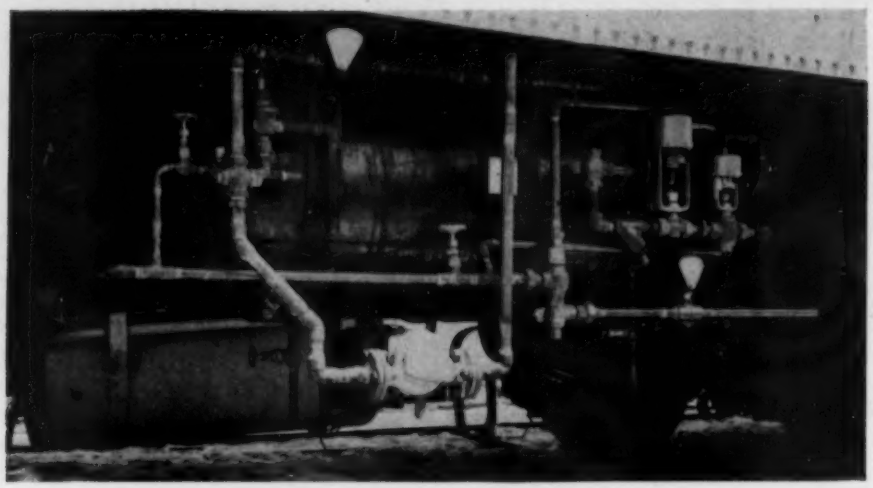
A logical approach to controlling atmospheric waste discharges would be a survey of all exhaust stacks on the roof. Each stack should be numbered, and data regarding the quantity and type of discharge tabulated. From these data, separate lists may be prepared of harmless, doubtful, and obnoxious discharges. Chemical and physical analyses will reveal additional information regarding the seriousness of the problem. At the present time, I am unable to make reference to prescribed standards for acceptable discharge rates for industrial atmospheric wastes.

There are a number of qualified equipment manufacturers available to handle dust collecting problems for the scrubbing and removal of mists, vapor, and gases from exhaust systems. For this reason, I will not take the time to discuss the means whereby these airborne wastes can be removed from exhaust stacks. However, attention should be directed toward the collection of dusts from the exhaust spraying booths, sand blast booths, brushing rooms, and from the mill room. Such dusts can be a neighborhood nuisance. Wash systems are recommended for removing acid, alkali, and cyanide vapors from the pickle system since any of these materials can be harmful or undesired in the surrounding neighborhood atmosphere. Gases in the stacks from ovens and furnaces usually are dilute and do not require attention.

In summary, airborne wastes are a subject of concern in many cases depending upon the particular plant problems, and should be evaluated by a competent person in order that the porcelain enameling plant can maintain an atmosphere both safe and free of annoying substances. Airborne wastes can be a detriment to the public relations efforts of any plant.

A portion of a ventilation system for pickling tanks in a porcelain enamel plant. Note covers on tanks to restrict steam from warm solutions. Vents provided where conveyor lifts are installed handle steam and alkali or acid vapors





Heat generating unit is enclosed in box suspended under car

Railway Car Has Radiant Heat in Floor

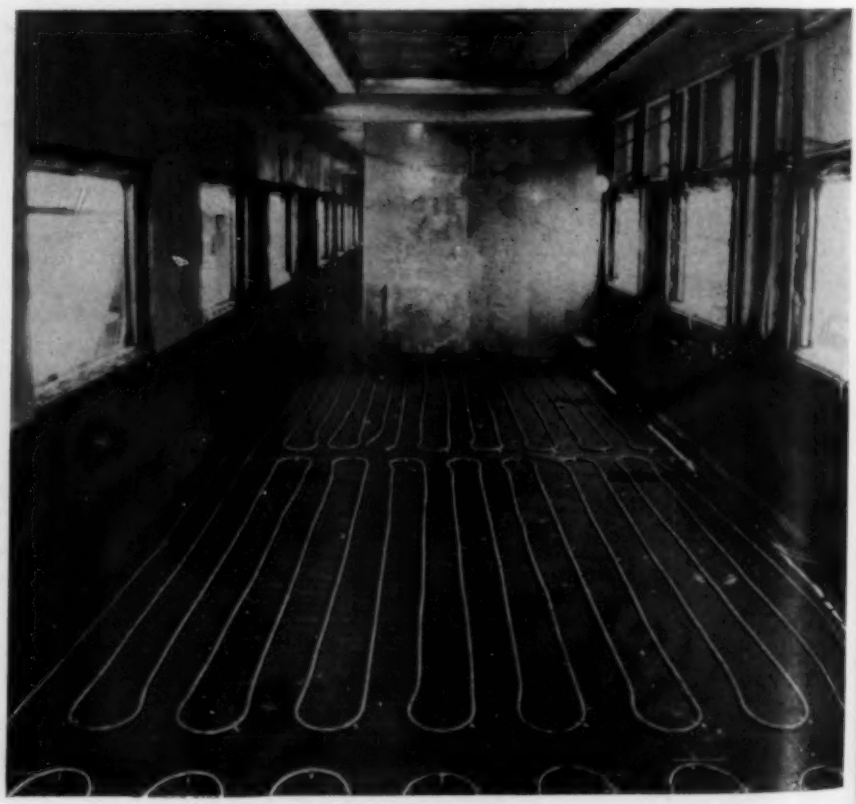
RADIANT HEAT with copper tube has been installed in a new deluxe railway car for President Aleman of Mexico by Robert Bruen & Son of Oakland, Calif. This is the first time a radiant heating system with copper tube has ever been used in a railway car. The car was built by the Ransome Co., Emeryville, Calif., under the supervision of Robert Palmer, personal representative of the President of Mexico. Six additional cars are being built and it is reported these may be the forerunner of some 8000 new passenger cars which will be constructed by the National Railways of Mexico. Copper tube for radiant heating will be installed in all cars.

The construction of the car floor for President Aleman's car consists of a ¼ in. thick steel plate. On top of this is a 1¼ in. thick oak board flooring and on top of the oak floor is a corrugated zinc sheet, the corrugations being on about 1 in. centers. The copper heating coils are ⅜ in. type L. The tube was laid out on top of the zinc sheet with strips of building paper separating the tube from contact with the zinc. A 1¼ in. thick mastic flooring was poured over the coils, embedding them. On top of this mastic is ¼ in. thickness of sponge rubber and a broadloom carpet is laid over the floor.

The heat generating unit is enclosed in an insulated steel box suspended below the car. Return risers from each separate coil are carried upward in the side wall to a return main located in what might be termed the "attic" of the car where an expansion tank and automatic air release are located. In each return riser is a thermostatic valve to control the temperature of the individual rooms. The mechanical equipment consists of a steel storage tank in which are inserted two heat exchangers. Steam from the locomotive will be passed through one heat exchanger at reduced pressure for the purpose of heating the water in the tank to a temperature of 180 F, automatically controlled.

Mr. Palmer and Mr. Bruen are now experimenting with both radiant heating and a cooling system in the other cars. Copper tube will be used for both. The coils for cooling will be in the metal sidewalls and ceiling.—*from the Copper & Brass Bulletin.*

Type L copper tube being installed for radiant heating in the deluxe private railway car constructed for President Aleman



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Explains a Method of Figuring Heat Losses from Basement Space

JOHN J. WOOLFENDEN, of the engineering staff of Smith, Hinchman & Grylls, Inc., architects and engineers, Detroit, writes entertainingly of the inaccuracies in building heat loss calculations and the need for "judgment" and "experience" to counteract the inexactness of formulas and methods. He explains a method for figuring losses from basement walls and floors

In view of the work that has been done in accurately determining the thermal conductivities of building materials—and despite the resulting improvements in the accepted methods of computing the heat losses from buildings—it must be admitted that, generally speaking, the accuracy of the experimental data is far in excess of the accuracy of the assumptions upon which their use is based. In fact, in some instances, the discrepancy is so great as to be almost absurd.

We cling tenaciously to some of these obviously questionable data as the proverbial drowning man grasps at a straw and for the same reason —nobody has offered anything more substantial to cling to.

For example, we base our computation upon a wind velocity of, say, 15 mph and then, because we know in spite of common belief to the contrary that low temperatures may be accompanied by high wind velocities, we tamper with the result to "compensate" for the greater air motion. And to show our lack of confidence in the final answer we add a percentage, independent of the exposure allowance, as a safety factor (or, as it has been far more correctly termed, a "factor of ignorance.")

Furthermore, what assurance is there, when we have computed a compound transmission factor for a wall construction, that the wall will be built exactly as the experimental wall was constructed or that such allowances as may have been made in the formula for faulty joints will cover the joints as actually made? We know that no workman will exactly duplicate his own work, no matter how conscientiously he may attempt to do so. His own physical condition, including that of progressive fatigue as the day advances, the weather conditions, and many other factors are against him.

Will Prevailing Wind "Prevail"?

Another very important consideration is the direction of the prevailing wind which, unfortunately, cannot always be depended on to "prevail" according to data. Take, for example, such a case as was brought to my attention several months ago.

The building was in an exposed location and, in the design of the heating system, due allowance had been made for the effect of the prevailing wind. Unfortunately, the first spell of really cold weather that was experienced after the building was occupied, brought with it a strong wind from a direction opposite to that from which the prevailing wind was supposed to blow. As a result, the building—or at least that part of it affected by the wind—displayed all the symptoms of an improperly designed heating system, in that the radiation was inadequate.

In such connections as these, it is well to note carefully the provision which has been often inserted in heating contracts, especially in the case of public buildings; that the heating system shall be adequate to maintain a temperature inside the building of not less than 70 deg with a stipulated outside temperature, irrespective of wind velocity, barometric pressure, or other atmospheric conditions. It is quite apparent even to a very superficial scrutiny that the heating engineer is in no position to split hairs.

While it may be interesting to know, from a scientific or laboratory point of view, that the thermal conductivity of a substance has been accurately determined to the third decimal place, and while it is true that inaccuracy of the other factors involved does not justify inaccurate determination where accurate determination is possible, it is also true that extreme accuracy in any one of a series of factors will not compensate for the inaccuracy of any of the others and the result will be of no greater percentage accuracy than that of the least accurate factor.

Consequently, we may say that we are not yet in a position to make full use of the most accurate of our data.

We must also bear in mind, however, that in order to gain accuracy we must not needlessly sacrifice simplicity, for to be of actual practical use, the formulas and the

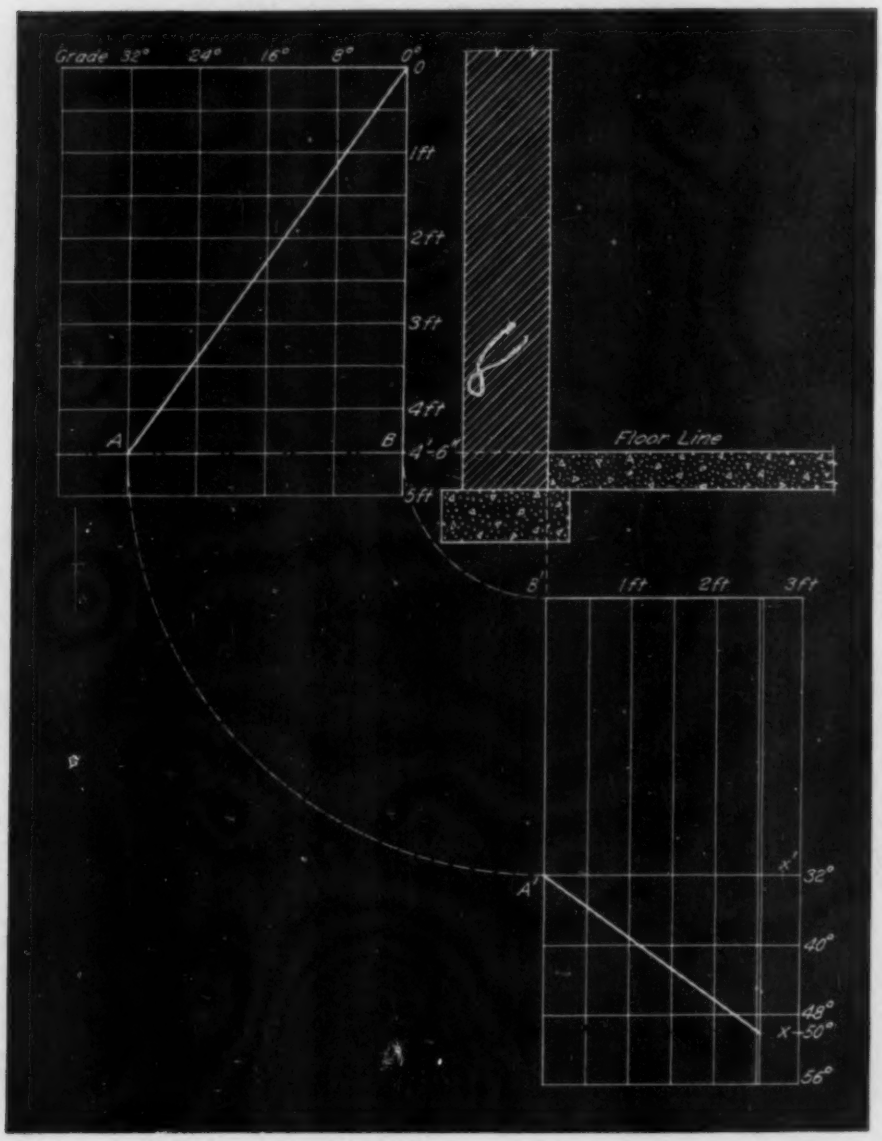
methods must be as simple and as direct as possible. Whether we like to admit it or not, the heating engineer deals with approximations and a simple, logical approximation, which is on the safe side without being too safe, is far more useful than an abstruse formula of great accuracy expressed by a complicated differential equation.

Judgment and Experience Needed

We often hear of "judgment" and "experience" as being involved in heating design. If the formulas and methods were exact and accurate, these would not enter into the picture at all. It is because the final result is obtained from compromises and approximations that they are necessary and justifiable.

I well remember an engineer—active in the days when building materials were more limited and construction more standardized than they are now—who figured the radiation requirements by the then accepted method; and then compared the results with those obtained by use of his favorite ratio of volume to square feet of radiation! If the discrepancy was appreciable, the results were "adjusted" until they agreed approximately with those of his volume ratio method. Although he undoubtedly believed that this radiation was figured by the accepted method, he actually might have just as well saved the time involved by going through with the process—as the final results were always close to those which would have been obtained by the volume ratio method alone. It would seem as if he had implicit confidence in neither method, or he would not have used both, although he apparently felt that the "rule of thumb" was safer.

Fig. 1—This illustrates the principles suggested for picking the outside temperature to use in figuring heat loss through walls and floors below grade. The lines *OA* and *A'X* show, respectively, the relation between temperature and depth or distance. The floor is treated as if it were a continuation of the vertical wall



Figuring Heat Losses for Basements

But it is when we leave the superstructure for the underground regions that we really begin to grope and to encounter the common condition of overheated basements.

Our knowledge of the building materials below the ground surface is as complete as before, but it is not so with the conditions of our outside surroundings. There have been many guesses as to what they might be and most of these were expressed by some form of thumb rule—a few of them have come down to us and are, in either their original or in a modified form, still more or less in use.

Among such rules, we find "use half the area of the wall below grade and figure as for wall above grade," "assume the ground temperature as 32 deg," which is almost the same thing, both being obviously incorrect and, likewise, illogical. Worse still is the assumption made by some that the ground temperature be taken as 50 deg over the entire basement.

Of late, there has been some investigation made of ground temperatures below grade, and there have been some attempts to apply the results of these investigations to heating problems (although it is evident, as acknowledged by at least the majority of the investigators, that the results so obtained are so far applicable only to the particular locality in which the experiments were made).

In view of this condition, I have worked out a method which (while not by any means free from assumptions and certainly not of unquestioned accuracy) is probably more accurate than many of the blanket methods which have been advocated in the past and is more logical and consistent by far.

As above pointed out, save for the outside conditions, the problem is the same as that involved in any heating computation. It is, therefore, with the outside conditions that we are primarily concerned—principally with those which affect

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the temperature of the ground.

Various tables and charts have been made which give the frost depth in various locations and it should be pointed out that while these are undoubtedly accurate on the basis of the data represented, they do not necessarily indicate the maximum frost penetration.

In considering ground temperatures, there are several factors which must be taken into account, such as the nature and condition of the soil. It is to be expected that the frost depth will be greater in the case of a hard, dense soil or a wet soil than in the case of a loose soil or a dry soil.

Furthermore, according to the best available data, there is no time lag in frost penetration; the maximum depth is practically coincident with the period of minimum air temperature.

What Is Normal Ground Temperature?

In attacking the problem, we must base our computations on two assumptions: the maximum frost penetration, and the normal ground temperature.

The first must be established on the basis of local data which must be interpreted with care. In my own locality, for example, I have, in the past, seen data giving the maximum frost penetration as 3 ft, 6 in., whereas it has been reported by those connected with certain utilities that they have found a frost penetration of 6 ft in some areas.

A customary assumption locally is that water pipes will not freeze at a depth of 5 ft and this seems to be generally the case. We might, therefore, logically assume a maximum frost depth of 4 ft, 6 in. in the absence of snow covering.

It may be asked why it is considered reasonable to make such assumptions in regard to the frost depth when water mains usually have more or less flow in them which tends to retard the freezing of the water; and, also, why it is considered legitimate to neglect the heat transmission in the wall slab, from center to edges (that is, vertically).

In reply to the first question, it may be pointed out that, while it is true there is usually more or less of a continuous flow in the mains, separate building service pipes are usually without flow for several consecutive hours out of each 24 hr and that these periods are customarily at night—usually the time of greatest cold. Furthermore, many of these pipes are ¾ and 1 in. in size and quite susceptible to freezing.

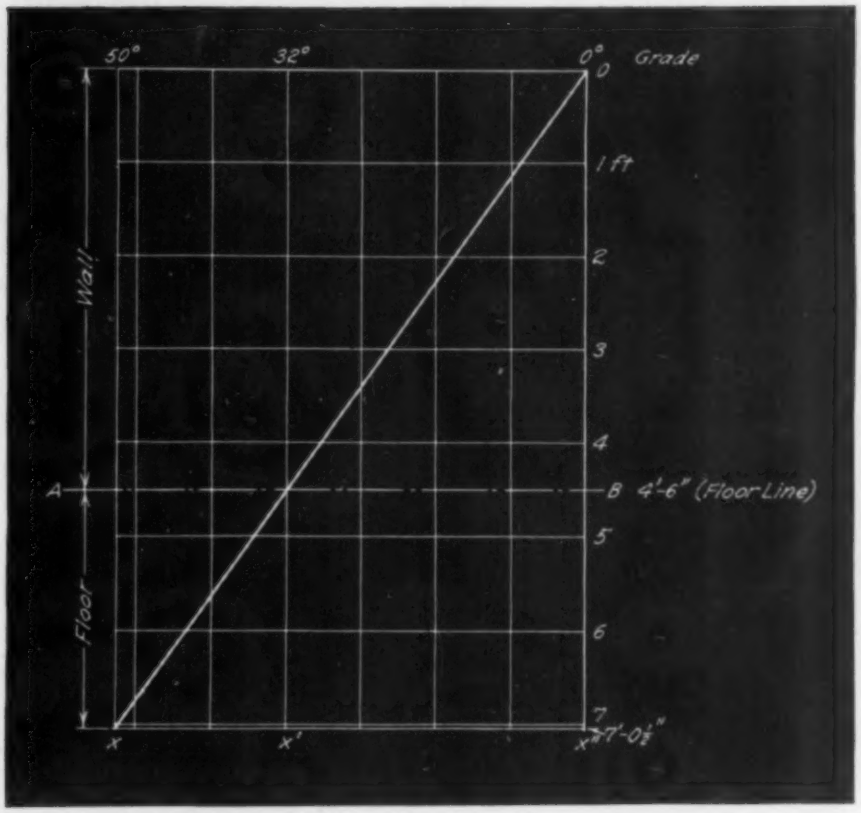

Fig. 2—Simplified version of Fig. 1. Once the frost depth for the locality has been determined, it is necessary only to draw a line parallel to *AB* or *XX"* at the proper depth, then apply the quantities obtained in the heat loss computations

To the second question, the answer can be made that, in figuring heat loss through walls above grade (especially in the case of buildings with concrete frame and floors) a certain amount of heat is transmitted to the walls by the floor slabs and some of this heat, at least, is diffused in the wall adjacent to the upper and the under sides of the slab, at the wall. It is not, however, taken into account in the heating computations. I believe that it is just as legitimate to neglect this effect in the one case as in the other.

It may be argued that the ground is not a homogeneous substance and that its nature and composition will vary not only from one location to another—even in the same district—but from foot to foot in depth, depending upon the nature of the various strata. The truth of this is evident but it is also evident that, if in a given locality, quiescent water in the service pipes does not freeze, they must be below the maximum frost depth corresponding to all but abnormal extremes or protracted periods of low temperature.

Examples Show Use of Method

If we assume an outside temperature as 0 F and a frost depth of 4 ft, 6 in., we have an increase of 32 deg over a distance of 4½ ft, or 7.12 deg per ft, the approximate average temperature gradient.

Since it is a common assumption in my locality that the "normal" (i.e., the fundamental) ground temperature is 50 deg, with a temperature change at the rate of 7.12 deg per ft the 50 deg temperature would be reached at a depth of 50 ÷ 7.12, or 7.02 ft.

If a basement is 8 ft deep below grade, 7 ft of this depth will be at an average temperature of (50 + 0) /2, or 25 deg, and can be so figured.

The heat loss so obtained is to be added to that due to the remaining foot of wall and to the basement floor, both figured on the basis of 50 deg outside temperature.

Suppose, however, the basement is of such a depth that the floor is above the computed elevation cor-

responding to the 50 deg temperature, what then?

Assuming that the basement is of a fair size and neglecting the heat transmission through the floor slab at right angles to its thickness (i.e., from mid-portion toward the edges), which will put us on the safe side as this heat transfer would tend to raise the average slab temperature somewhat toward the edges, we can apply the same method.

For example, suppose that the floor is at a depth of only 4 ft, 6 in., other conditions remaining as before. This depth corresponds to a temperature of 32 deg but we still have the difference of 18 deg (50 — 32) to account for before we reach the stable ground temperature.

This difference we can apply to the floor and since (50 — 32)/7.12 = 2.53 ft, a strip around the outside edges of the floor of this width, is to be figured with an average outside temperature of (50 + 32)/2, or 41 deg, while the remainder of the floor is to be figured with the outside temperature of 50 deg. The wall above grade should, of course, be figured in the customary manner.

It is evident that, by this method, the floor is treated as if it were a continuation of the vertical wall, as regards outside conditions. This seems to be quite logical, as the outer edges of the floor adjacent to the wall are obviously at a lower temperature than the center. The principle is illustrated in the analytical diagram in Fig. 1, which is simplified in Fig. 2.

It is not claimed that this method is free from fault or exempt from criticism; neither is it offered with the intention or expectation that it will be adopted or accepted without question. The method is intended as a suggestion for consideration—and each must modify it as required in his opinion to adapt it to his needs.

It is to be noted that, once the frost depth is determined, a diagram similar to that in Fig. 2 may be drawn regardless of the depth of the floor below grade as, for varying floor elevations, it is necessary only to draw a line parallel to *AB* or *XX"* at the proper depth, whatever that may happen to be, and then apply the quantities so obtained in the computations for wall and/or floor loss as required.

Geiger Counter Used to Detect Lead in Air

A new instrument capable of detecting lead in the air in amounts at least as low as one part in 20 million was described by Henry Aughey, of the chemical department of E. I. du Pont de Nemours and Co., before the Optical Society of America. It gives promise of adaptation for detecting in the air other toxic metals encountered in certain manufacturing processes, he said.

The instrument's extreme sensitivity can be maintained in routine operations, and determinations of lead content can be made almost instantaneously, he stated.

The instrument was developed, Mr. Aughey explained, as additional insurance of the highest possible degree of safety in tetraethyl manufacture.

Although the device has been tried only for lead, similar sensitivity in detection of other metals, both in elemental and combined forms, is to be expected.

To aid in visualizing the sensitivity of the instrument in detecting one part of lead in 20 million parts of air, it was observed that one ordinary BB shot, ground into extremely fine powder, would have to be dispersed in about 500,000 cu ft of air to give content that low.

This means, it was pointed out, that lead can be detected and danger to employees avoided long before the amount of lead in the air reaches dangerous proportions. The instrument is mobile; it may be wheeled to all parts of the plant for regular air inspections. With an early model, determination of lead content took about an hour, but with an improved modification, detections can be made virtually instantaneously and continuously. The device is far more sensitive, and faster, than all previously known orthodox chemical methods.

In theory, the new instrument is quite simple, Mr. Aughey said. Air from the area under investigation is drawn through a tube in such a way that it passes through an electrical spark discharge, with the result that it emits light. Light given off by any particular metal in a spark discharge is different from that given off by other metals, just as the fingerprints of one person differ from those of all other persons. All the light coming from the spark discharge is passed through a quartz spectrograph where it is broken up into its different component parts, just as ordinary light is broken up into a spectrum of rainbow colors by passing it through a glass prism. If any lead in the air is drawn through the spark, it emits ultraviolet light which shows up as a narrow band in one particular spot on the spectrum.

In the original instrument, the band of light which resulted from the presence of lead was allowed to fall on a photographic plate, which was subsequently developed. The density of the resulting image was a measure of the amount of lead present in the air. In a later modification now employed, the band of light caused by the presence of lead in the air is passed into a photoelectric Geiger counter. This gives rise to a pulsating current of electricity, the strength of which depends upon the intensity of light going into the photoelectric counter. The intensity of this light, in turn, depends upon the amount of lead in the air which was passed through the spark discharge.

PROFIT FOR DIVIDENDS UP 34 PERCENT

Operations of General Electric Co. and its consolidated affiliates for the first nine months of this year resulted in a profit available for dividends of $83,893,459, an increase of 34 percent over that earned in the corresponding period last year, according to President Charles E. Wilson. The earnings for nine months this year were equivalent to 7.4 cents per dollar of sales and to $2.91 a share of common stock, compared with 6.8 cents and $2.17 in the same period a year ago.

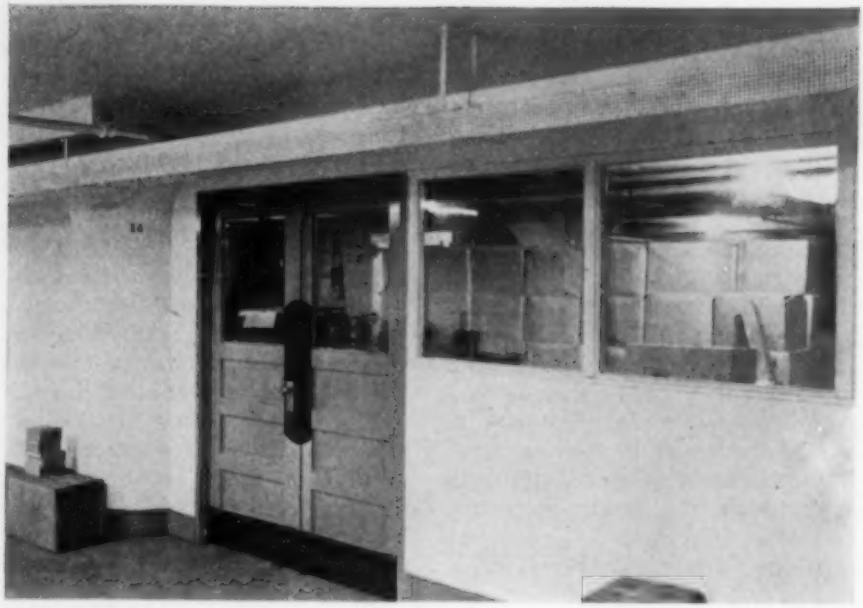

Fig. 1—In this case, a duct of perforated board construction is used to supply air uniformly for process air conditioning work

Process Air Conditioning
Valuable Production Tool

AIR THAT HAS been properly conditioned and is delivered under control at all times is a valuable tool to work with in many manufacturing processes. This is far removed from what is ordinarily associated with the words "air conditioning." Too many of us think only in terms of "comfort cooling"—something involving a reduction in temperature for summer comfort.

There are two types of air conditioning. There is the common type of "healthful" air conditioning which is designed primarily for people in stores or offices or homes, and there is the industrial or process type which is used to assist or insure production under controlled conditions. In many cases, of course, consideration must be given to the effect on the person working under the condition required for the product.

In process air conditioning, as used in pharmaceutical manufacturing, the control of air temperature, humidity, cleanliness, purity, and circulation are emphasized, as these are the qualities of prime importance.

In order to meet the temperature, humidity, cleanliness, or other requirements of process air conditioning installations, the question of uniform air distribution must often be given very special consideration by the air conditioning engineer and contractor. For example, let us consider the sterile inoculation room at a plant built during the war for the manufacture of penicillin by the flask method.

In this room the flasks of penicillin culture media were inoculated with the spores and here it was necessary to hold 75 F dry bulb temperature and 45 percent relative humidity without drafts. Bunsen burners were used for sterilizing the inoculating wire and any air motion not only stirred up dust currents but interfered with the proper handling of the gas flames. A straight duct in the center ceiling constructed of perforated board was used to solve this draft problem. The walls of the room were fitted with sterilizing lamps, and the air supplied to the room passed through an electrostatic filter and chilled water cooling and dehumidifying coils. No air was recirculated.

Air Drifted Across Room

After inoculation, the racks of flasks were taken into the incubation room, where they were held for a period of six days. The problem in this room was to hold uniform temperature and humidity over its entire width, length, and height.

LESTER T. AVERY, president of the Avery Engineering Co., Cleveland, points out that there are two kinds of air conditioning—one of them is for comfort and the other is for industrial process work. The problem of uniform air distribution is often a critical one in process applications, and he explains how it was solved on some of his own jobs. His remarks have been taken from a recent talk on air conditioning before the western section of the American Pharmaceutical Manufacturers' Association

Obviously, if it were colder on one side of the room than the other, the mold growth would be different. Here, a special perforated board air distribution method was worked out so that the air was drifted across the room at a very high air change rate—something more than one complete change per minute. Temperature readings across the room showed less than 1 deg variation. The air conditioning unit, suspended from the ceiling, was custombuilt to allow clearance for walking underneath, and was fitted with a chilled water coil, electric strip heaters, fan, and air distribution ducts. Most of this air was recirculated.

In the purification laboratory, a special ventilation problem developed due to alcohol fumes—which created a real industrial health hazard. Originally, the air was brought in from grilles in the overhead duct shown in Fig. 2. This stirred up the fumes and it was impractical to handle enough air to keep the fume concentration below the tolerable limits. Exhaust was taken from the floor and from the ceiling, but excessive exhaust could not correct the problem. The perforated panels shown in the photo were later added to supply air which "drifted through" the workers to the exhaust outlets and corrected the contamination. This principle of "drifting" air is of great help in many fume or dust problems, in my experience.

In a similar installation at another plant, a fume problem arose because of the use of solvents of the carbon tetrachloride type. The air at low humidity was recirculated and was purified by activated carbon cells.

The choice as to using recirculating air and purifying it, or using all outside air and bringing it to the required inside condition, must be given careful consideration in planning air conditioning systems. In general it is better practice to use plenty of outside air—even up to 100 percent. Where there are low temperatures or low humidities (or both) to be maintained in the conditioned space, it pays to recirculate.

SMALL BUSINESSES AT HIGH MARK

The number of small businesses in the country today, per thousand of population, is as large as at any time in our history and numerically there is no downward trend in sight, according to a report on Small Business: Its Place and Problems issued recently by the Committee for Economic Development. This does not rule out "the probability that the next few years will see a weeding out among the small businesses that mushroomed in the wartime and postwar sellers' market."

Fig. 2—Supply air enters the room through these perforated panel boards, and "drifts" across the room to maintain uniform conditions

$1.5 BILLION FOR SCHOOLS, CHURCHES

Nearly $1.5 billion has been spent for construction of new school buildings and churches since the end of the war, Melvin H. Baker, chairman of the Construction Industry Information Committee, stated in October.

"Construction of new educational and religious buildings totaled nearly $600 million in the first eight months of 1948 alone and led all other types of nonresidential construction in the upswing over 1947," Mr. Baker said.

"An analysis of Bureau of Labor Statistics' reports for the first eight months of the year shows $460 million worth of new educational buildings put in place—an increase of 78 percent over the first eight months of last year. The urgent attention being given to educational building programs is even more clearly shown in the fact that dollar volume so far this year is 5 percent greater than for all of 1947.

"Both increased enrollments in elementary schools as a consequence of the rising birthrate of the early 1940's and the record enrollments in colleges and universities aided by veterans' benefits have stimulated this rapid increase in construction of educational facilities. Our study shows that private institutions have increased their expenditures from prewar levels relatively more than public agencies for added educational facilities to meet the current pressing needs.

"Reflecting the higher college enrollments, private expenditures of $144 million in eight months of 1948 are considerably greater than for any full year before the war, while public expenditures of $316 million in the same period are considerably below annual totals of $418 million reached in 1939, and $400 million in 1925.

"Religious construction is smaller in volume than educational building, but has had an even more striking rise.

"We see in this upsurge a natural fulfillment of the needs of a prosperous and democratic nation," Mr. Baker said. "Without regulation of any kind, these types of construction have come to the forefront, leading even commercial construction in the improvement over last year."

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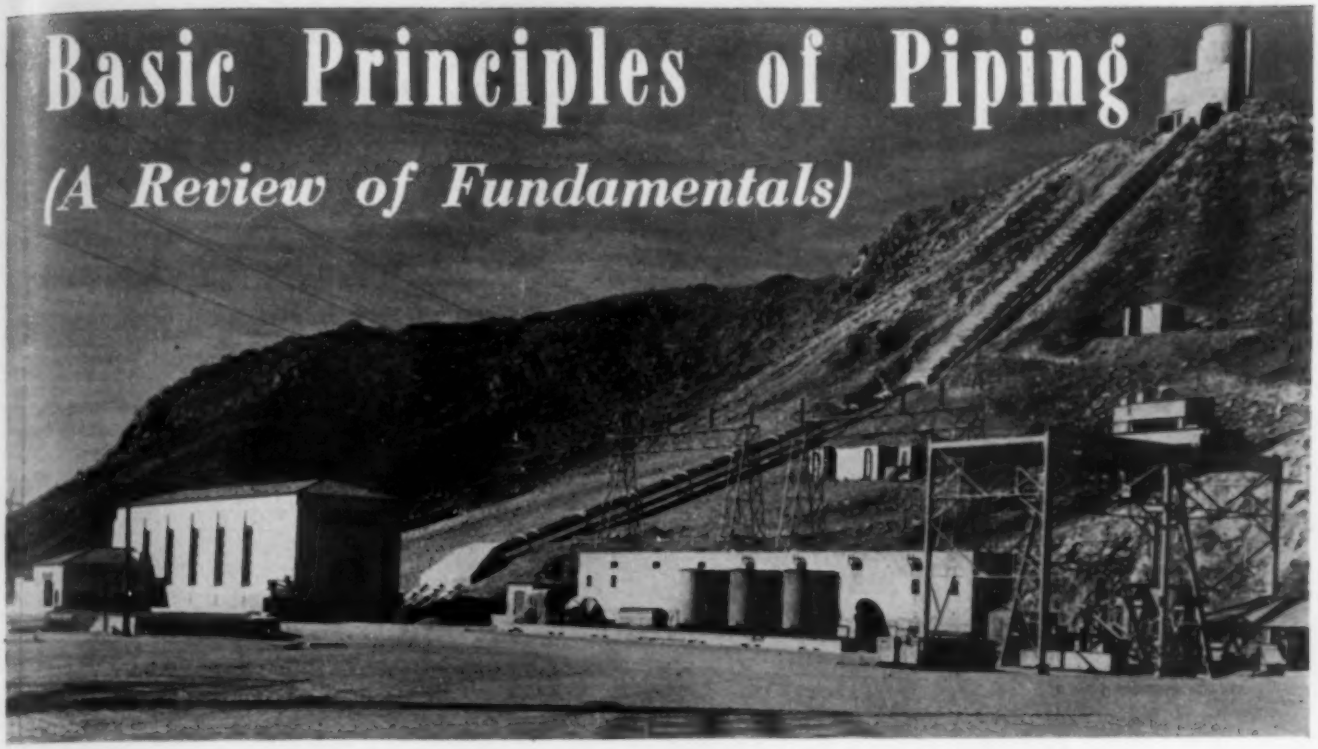
Basic Principles of Piping

(A Review of Fundamentals)



Careful consideration of piping fundamentals must be given in the design of a large water pumping station such as this one in southern California

HERMAN VETTER, consulting engineer, Los Angeles, a specialist in industrial refrigeration, air conditioning, and ice rinks, gets down to fundamentals in the articles of which this is the first. His aim is not to replace existing publications on the subject of piping but to supplement them by discussing elementary principles

PIPING IS A means of conveying fluids from one place to another, such as the mains which convey water from reservoirs to homes and industrial plants. In industrial plants, piping is the means of conveying steam from boilers to engines and heaters. In refrigerating plants, piping is the means of conveying refrigerants, chilled water, or brine from cooling systems to the rooms or units to be cooled. Piping is also used for conveying semi-solids, and for very viscous materials.

Quantity—It is necessary that we have some measurement for determining the amount of fluid to be conveyed. In the case of water, the measurement would either be cubic feet, gallons, or pounds. For air or other gases, the measurement would either be cubic feet or weight in pounds.

Rate—In addition to the amount or quantity of fluid to be conveyed, we must also know the time or rate for conveying a given quantity. In the case of water, we must know the gallons per minute (gpm) and for gases, the cubic feet per minute (cfm). In the case of extremely large quantities, such as large hydraulic systems or large steam generating plants, the quantities are given in cubic feet per second (cfs). Pounds per hour (lb per hr) is also a rate, of course.

Velocity—Pipe line velocity is the speed at which a fluid passes through the pipe and is stated in feet per minute (fpm) or feet per second (fps). Velocity is usually understood to be the average velocity in a pipe. There is considerable difference between the velocity at the core or center of the pipe and at or near the walls of the pipe. The higher the velocity, the greater this difference.

What Determines the Flow Rate?

In order to determine the amount of fluid that can be conveyed through a given size pipe, we must know what factors control the rate of flow. To illustrate these controlling factors, Fig. 1 has been prepared; it shows a tank 10 ft in diameter and filled with water 10 ft in height. This tank has a 4 in. outlet in the bottom.

In calculating pumping problems, pressure can be expressed either in pounds per square inch (psi) or in feet of head. A column of water (at 62 F temperature) 1 in. square and 1 ft high weighs 0.433 lb; therefore, the weight at the base of the 1 ft column will exert a pressure of 0.433 psi.

The pressure at the bottom of the tank in Fig. 1, when the tank is full of water, would therefore be 4.33 psi. The pressure at the bottom of a tank is governed by the head and is not affected by the volume. In other words, a tank containing 100 gal or one containing 100,000 gal would have the same pressure per square inch at the bottom of the tank providing the depth of water in each tank was the same.

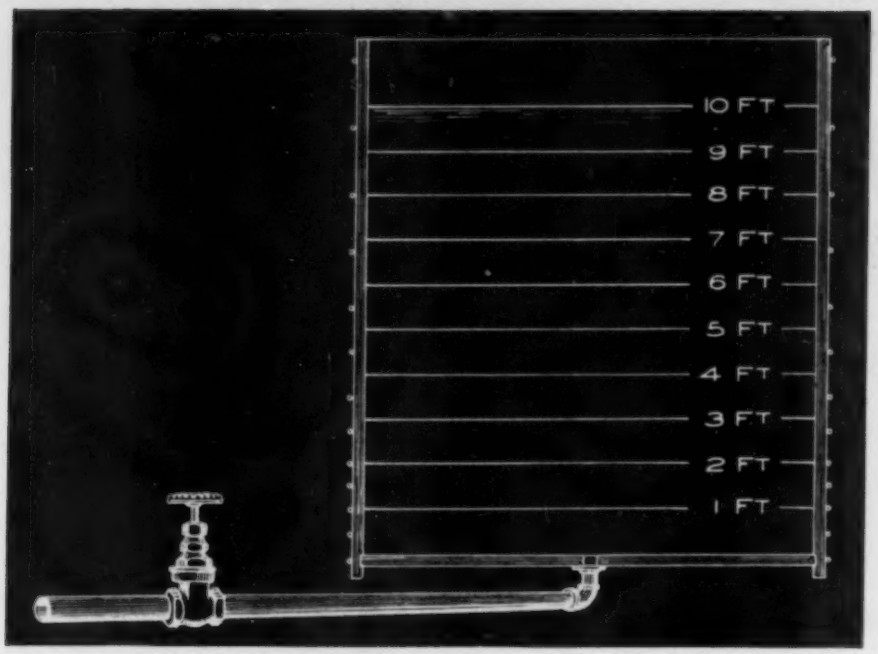


Fig. 1—When the valve is opened, water will start to flow from this tank under a 10 ft head, which is equivalent to 4.33 psi pressure

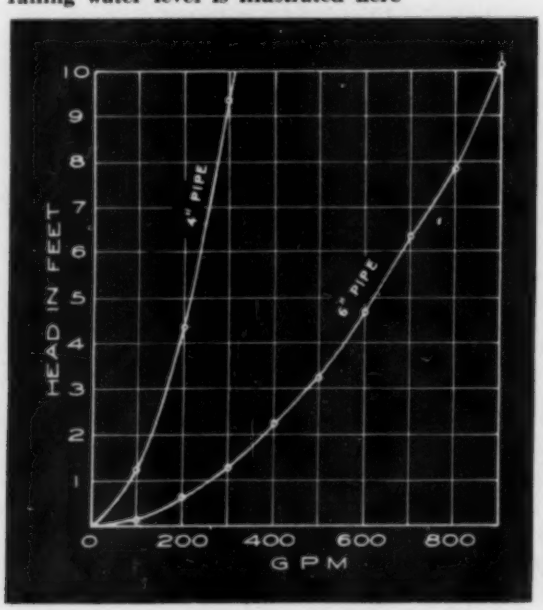
Let us assume that we open the valve on the tank illustrated in Fig. 1. When this valve is opened, water will flow through the 4 in. pipe under a head of 10 ft which corresponds to a pressure of 4.33 psi. As soon as the water begins to flow, the water level will recede; therefore, as the tank empties the rate of flow through this pipe will diminish.

The change in rate of flow due to the difference in head is illustrated in Fig. 2. In the first foot of fall of water (from 10 ft to 9 ft head) the average rate of flow through the 4 in. pipe would be 300 gpm. When the water has dropped to the 1 ft level, the average rate of flow will be 44 gpm. Fig. 2 thus illustrates the relation of head or pressure to rate of flow.

The time required to empty the tank shown in Fig. 1 is illustrated in Fig. 3. It would require 40.3 min to empty the tank through the 4 in. line. If we installed a second 4 in. line, we could empty the tank in half of that time, or 20.15 min.

If, however, instead of two 4 in. lines we had one 6 in. line, which has approximately the capacity of two 4 in. lines, we could empty the tank in 11.9 min. A 6 in. standard weight steel pipe has an internal cross sectional area of 28.89 in. as against an area of 25.46 sq in. for two 4 in. lines. The reason that the 6 in. line has more capacity than the two 4 in. lines is mainly due to the fact that the inside circumference of the 6 in. line is 19.054 in., whereas the circumferences of two 4 in. lines total 25.296 in. The inside surface of the pipe represents the friction area; consequently, the two 4 in. lines have 32 percent more friction surface than the 6 in. line. The rate of flow of the 6 in. line is also shown in Fig. 2 at the bottom of this page.

Fig. 2—Change in rate of flow from the tank shown in Fig. 1 as the head decreases due to the falling water level is illustrated here



Power Required for Pumping

The next step is to know how to determine the amount of power required. The measurement of power is usually expressed in terms of horsepower. Horsepower is the amount of power required to raise a 1 lb weight 33,000 ft in 1 min, or in variables as listed below:

		Horsepower			
1 lb	×	33,000 fpm	=	1	hp
10 lb	×	3,300 fpm	=	1	hp
33,000 lb	×	1 fpm	=	1	hp

A weight of 1 lb falling 33,000 ft in 1 min will impart as much power as is required to lift a pound weight 33,000 ft in 1 min. However, due to loss of power from friction and from leakage, there will be some losses and, in the case of pumping water, the efficiency of the pump may vary from 60 to 85 percent. There are some very large pumping installations where the efficiency is as high as 92.5 percent.

The method of calculating the power required for pumping is as follows:

$$Hp = \frac{\text{Gpm} \times \text{Lb per Gal} \times \text{Head in Ft}}{33{,}000 \text{ Ft-Lb per Min} \times \text{Percent Pump Efficiency}}$$

The following example illustrates the use of this equation. Assume 80 percent efficiency, 300 gpm capacity and 50 ft head, the weight of water being 8.33 lb per gal at the temperature involved:

$$\frac{300 \times 8.33 \times 50}{33{,}000 \times 0.80} = 4.73 \text{ hp}$$

In this example the pump efficiency was assumed as 80 percent; this is not a constant quantity, as the efficiency of pumps varies depending upon type and pump selection.

Flow Through Pipes

The next important step is the study of the flow through pipes so that the resistance can be determined. The total head or resistance may be divided into five parts:

H = Velocity head.

H_1 = Loss of head at entrance.

H_2 = Loss of head through friction.

H_3 = Loss of head due to obstruction.

H_4 = Loss of head due to bends.

Velocity Head—This head represents the theoretical as required to

keep a body in motion and varies as the square of the velocity. The term "theoretical" means "without loss," and as used here means the head required for moving a fluid through a frictionless pipe. It may be expressed by

$$H = \frac{v^2}{2g}$$

where H = velocity head in feet; v = velocity in feet per second; g = acceleration of gravity, or 32.16 feet per second per second.

Fig. 4 has been prepared to indicate the velocity head for velocities from 1 to 10 fps, and it will be noted that the head increases rapidly. The velocity head is independent of the size of pipe or length of run.

Loss of Head at Entrance—The head required to overcome the resistance of the flow entering a pipe is always less than the velocity head; and when the conditions are not specified, it is usually taken as being equal to one-half the velocity head, which is the condition for sharp edged entrance.

Fig. 5 shows the three usual types of entrances; "A", sharp edged entrance, "B", slightly rounded entrance, and "C", bell-mouth entrance. The method of calculating the loss at entrance is

$$H_1 = K_1 \frac{v^2}{2g}$$

The values of the K_1 factor for these three types of entrances are as follows:

A, Sharp edged entrance.....0.50
B, Slightly rounded entrance.0.23
C, Bell-mouth entrance.....0.04

In order to visualize why the bell-mouth entrance has a much lower K factor than the sharp edged entrance, Fig. 8 indicates the sharp edged entrance at the left and the bell-mouth entrance at the right. As turbulence plays an important part in this matter, the following discussion of turbulence is given at this point.

Effect of Turbulence

Water (for example) flowing against an immovable object, such as the walls of a pipe, has a rolling or agitated action especially when the velocity is high. The turbulence becomes less the closer the water is to the center of the pipe. When the average water velocity is low, no turbulent condition exists—as can be readily visualized if we had, say, a 24 in. water main and only the amount necessary to supply a 2 in. line was being drawn from this main; under this condition, the main body of water, especially near the walls of the pipe, would be motionless. The higher the mean velocity, the greater the area of turbulence that would exist.

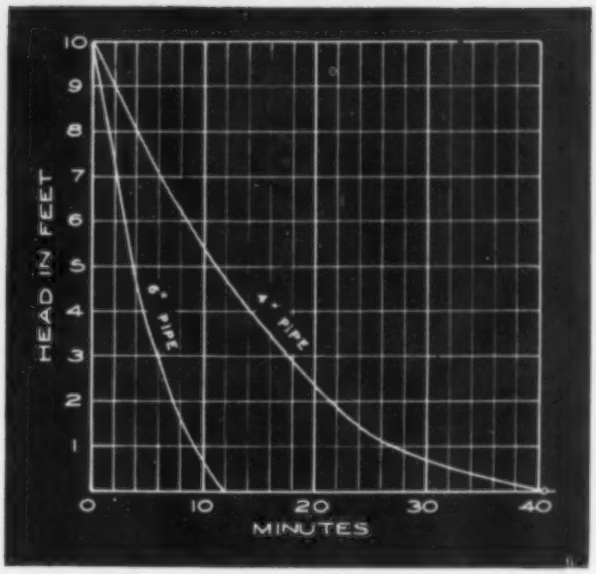


Fig. 3—The time required to empty tank in Fig. 1 if a 4 in. or a 6 in. outlet is used

To visualize the flow through pipes, Fig. 7 has been prepared. The top sketch indicates high velocity, the middle one medium velocity, and the bottom one low velocity. As previously mentioned, the velocity is not constant, and the straight horizontal lines contained within the curve represent the variations in flow velocity, while the curlicues indicate turbulence. The types of flow are shown as turbulent flow, transition flow, and laminar flow. There are times when a turbulent flow is desired, such as for heat transfer purposes, but it is not desirable for conveying fluids economically.

Entrance Flow — The flows of fluid toward the entrance are indicated by arrows in Fig. 8. In the sharp edged entrance (left view of Fig. 8) the line of flow near the edge of the entrance strikes a flat surface headon. According to the principles of force, the line of force striking a surface is deflected at the same angle at which it strikes the surface. This would be true if it were a force such as a steel ball, but in our case the force consists of a solid column of water; therefore the force is diverted horizontally in all directions. Part of the force is therefore directed toward the pipe entrance; this line of force counteracting parallel lines of force directs the water toward the center of the pipe as indicated by the arrows. This action creates a turbulent area as indicated, which retards the flow into the pipe in like manner as if the pipe entrance had an obstruction.

In the bell-mouth entrance on the right of Fig. 8, the shape is designed to direct the lines of force into the pipe parallel and as close to the entrance wall as possible to

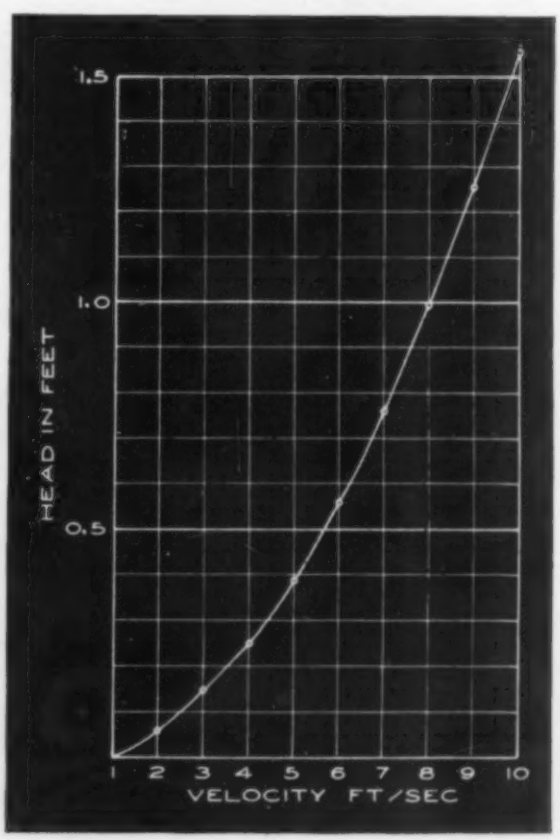


Fig. 4—The relationship between velocity head and velocity

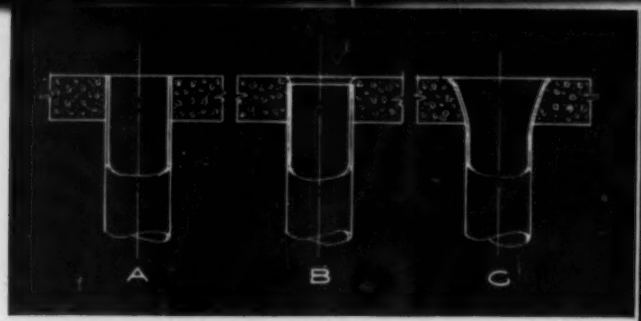


Fig. 5 (left)—Shape of the entrance to a pipe affects the entrance loss

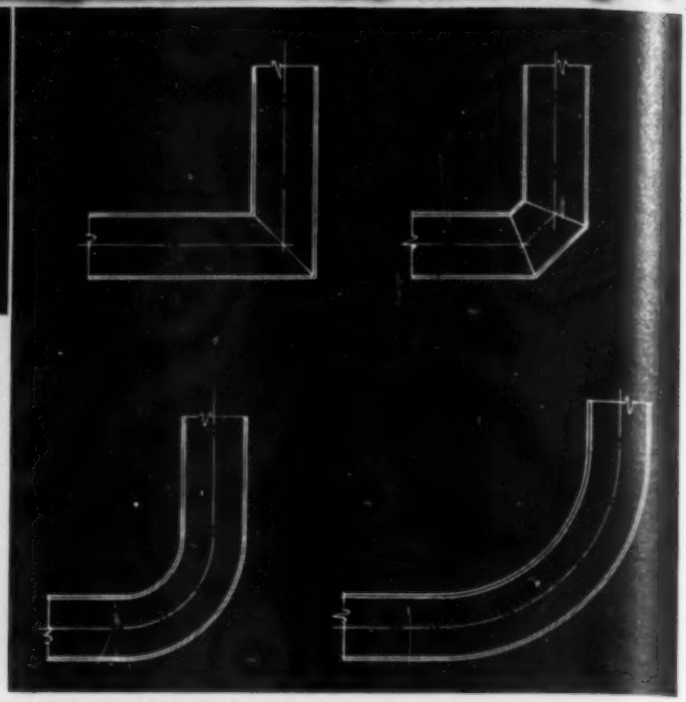


Fig 6—(right) Four types of piping bends, each of which causes a different loss in head or pressure

avoid the formation of a turbulent area. It will be noted that in the bell-mouth entrance, the greatest concentration of force is at the wall surface where it is most needed; whereas, in the sharp edged entrance, the concentration of force is at the center where the resistance is the least.

Loss of Head Through Friction—The loss of head due to the friction between the moving water and the inner surface of the pipe is the most important to be considered in connection with the flow of water in pipes. The method of calculating the loss due to friction is

$$H_2 = K_2 \frac{l}{d} \times \frac{v^2}{2g}$$

where K_2 = a factor (values for which can be secured from text books); l = length of pipe in feet; d = diameter of pipe in feet; v = velocity in feet per second; g = acceleration of gravity, or 32.16 feet per second per second.

Loss of Head Due to Obstruction—The most common obstructions in pipes are valves, especially globe valves and gate valves when partly opened. The method used to calculate the loss due to obstructions is

$$H_3 = K_3 \frac{v^2}{2g}$$

The values for factor K_3 can be secured from text books or manufacturers' data books.

Loss of Head Due to Bends—The loss of head due to bends is governed by the velocity, and by the radius of the bend. The following is the method for calculating the loss due to bends.

$$H_4 = K_4 \frac{v^2}{2g}$$

The values for factor K_4 can be secured from text books.

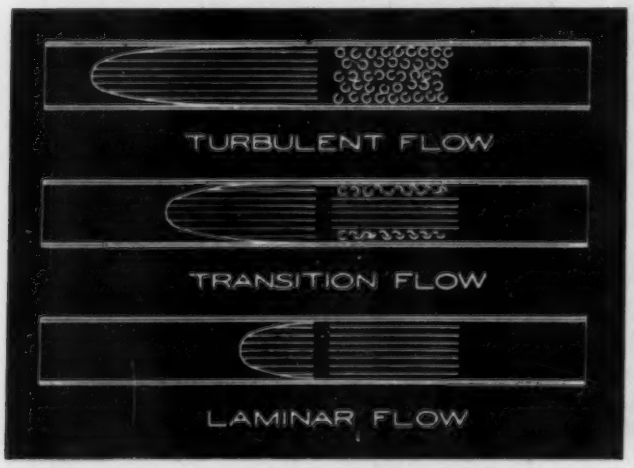
Fig. 6 shows four types of bends, a single miter bend, a double miter bend, a short radius bend, and a large radius bend. The single miter bend should never be used because the water entering the bend strikes the pipe wall head-on, creating excessive turbulence. Short radius bends usually have a radius of 1½ times the pipe diameter; for instance, a 4 in. bend would have a 6 in. radius, measured on the centerline. The comparison in head between the single miter bend and the short radius bend is 1.00 to 0.20 which means that the total head of five short radius bends is not more than the resistance of one single miter bend. The ideal radius of a bend so far as pressure drop is concerned has been found to be between two and one-half and three pipe diameters.

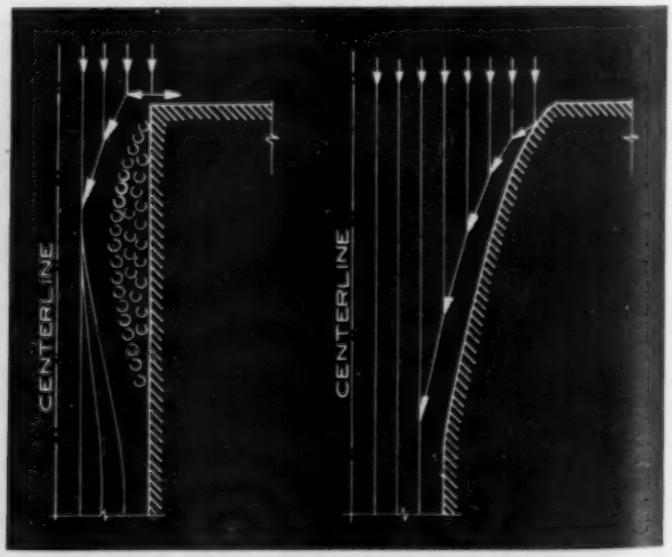
* * * *

Your January issue will include a complete and up-to-date Directory Section of Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional, and Public Buildings.

Fig. 7—(left)—Three types of flow in piping, the velocity and the properties of the fluid determining which of them exists in a given case

Fig. 8 (right)—Flow of a fluid toward entrances





QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

How to Make a Speech on Trends in Your Business

As the Question of the Month published in the October HPAC, "R.H.C." said he was scheduled to make a talk before a luncheon meeting of businessmen on some of the significant trends in heating, ventilation, and air conditioning. He asked for comment on what to include so that he won't neglect anything that should be brought out

"AIM WELL and shoot straight!" This would be my suggestion to "R.H.C." who states, in his Question of the Month published in the October HPAC, that he is to make a luncheon speech on significant trends in heating, ventilation, and air conditioning to a group of businessmen.

Businessmen either work for someone or are in business for themselves. Whether their interest is in behalf of their employer or themselves, their interest in air conditioning trends is probably in the need (though not necessarily the desire) to purchase new equipment or to replace old equipment in either an existing or an as yet unbuilt building. Their interest can undoubtedly be classified further as stemming from either a profit or a necessity viewpoint. If this analysis is correct, then *aim* well at what your listeners wish to hear and *shoot* straight in your presentation!

Businessmen are not particularly interested in the numerical value of the coefficient of performance of a heat pump when using an air-to-air system. Two—or even 20, for that matter—would have little meaning to them.

However, the relative installation and operation costs of heat pumps, radiant heating systems, and other relatively new developments compared with the advantages and disadvantages of these systems is of interest. Comparison with the so-called conventional heating and cooling systems is probably of great interest to the man who has his own or his employer's interests at heart. The costs of installation today compared with those of a year ago and five years ago have meaning when compared on a purchasing power or "real" value basis. Probably much more important than current costs, however, are other trends which interest the businessman.

Air Conditioning a Business "Must"

The general public no longer views air conditioning as a novelty yet to be tried. It is important to point out to present-day businessmen that air conditioning is no longer a luxury, but has become a business "must"—a dollar maker requiring a relatively low initial investment! Employers are accepting the proved fact that employees are much more efficient when comfortable. Salesmen are realizing more and more that customers are more inclined to make purchases in pleasant surroundings. Vast improvements have been made in air cleaning systems, and at practically no increase in real investment. A layer of dust or grime is probably yet to demonstrate its ability to help a businessman close a sale, whether the item is a collarbutton or an automobile.

The trend toward compactness in equipment design should also be brought to light, for the dollar today doesn't represent the same square footage of building or office

space that it did 10 years ago. Reduced space requirements mean reduced overhead to all who are financially responsible for building occupancy. Even in home conditioning units, the trend is toward minimum floor space requirements.

Compare New and Old Equipment

Increased compactness of equipment may be readily demonstrated with models, pictures, or charts which compare the characteristics of "new" and "old" equipment. When applicable, pictorial or prototype representations are very beneficial to any speaker inasmuch as they leave a greater lasting impression with the audience by appealing to two senses, the eye and the ear, rather than just the ear. Naturally, the businessman is interested in visual representations which are easy to comprehend and which have portrayed vividly items of direct interest to him.

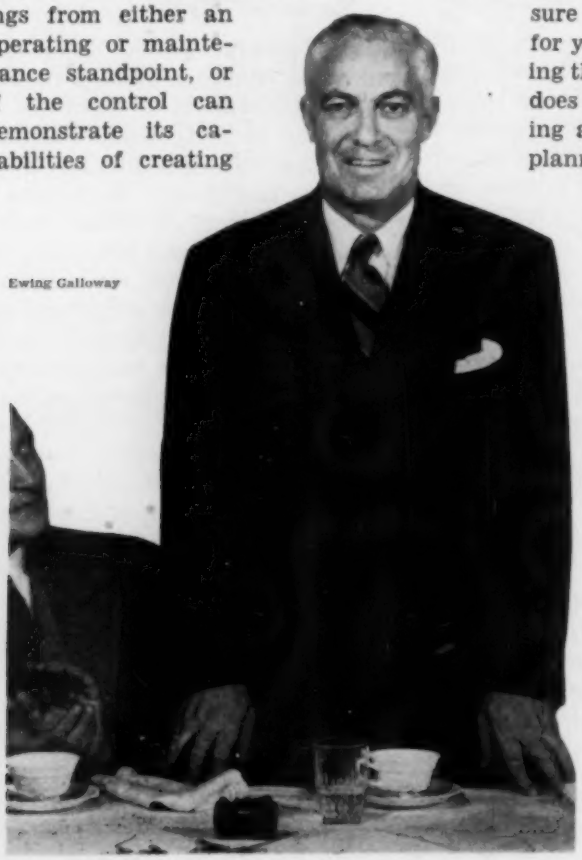
Another trend which can be demonstrated readily is the improvement of control systems. These improvements are of interest to the businessman particularly when new systems can show immediate savings from either an operating or maintenance standpoint, or if the control can demonstrate its capabilities of creating more healthful or comfortable conditions.

Summarizing, probably one of the most important trends during the past few years is that of the changing attitude of the public toward air conditioning. The fact that financial gain results by using air conditioning is receiving widening acceptance, and this gain is constantly being increased by the production of more efficient equipment and by the use of more efficient methods of design, fabrication, and installation.

Other factors which are gaining recognition are the reduction of cleaning costs; a huge variety of so-called intangible benefits such as goodwill, advertising, a feeling of well-being associated with a certain place of business; more flexible and efficient controls without which most systems would be ineffective; the reduction of space requirements; and last but not least, current cost trends.

"Git Up, Tell 'Em, Sit Down"

Since the original question pertained primarily to "aim," it is assumed that "R.H.C." is somewhat experienced in "shooting straight." Briefly then, shooting straight may well include such things as being sure the subject is meant for you, adequately preparing the presentation (which does not include memorizing any speech any time), planning and—if necessary—practicing the delivery, and omitting "funny" stories unless you are an expert. Length of speech should be carefully considered. Lincoln's Gettysburg address is certainly one of the most famous speeches in the world—it was delivered in less than five minutes. To hold the attention of an audience much more than two or three times this long requires exceptionally careful preparation and an outstanding presentation.



Ewing Galloway

"Git up, tell 'em what you're gonna say, say it, tell 'em what you said, and sit down."

In the overall picture, an analysis of the desires of the audience should be made, and then the information should be presented enthusiastically and accurately. As it has been somewhat ungrammatically stated: "Git up, tell 'em what you're gonna say, say it, tell 'em what you said, and sit down."—J.E.Y.

MUCH ADVANCEMENT IN PAST DECADE

In answer to "R.H.C.'s" question in the October issue of HPAC, I submit the following:

"As you are all well aware, there has been considerable advancement in the field of heating, ventilating, and air conditioning in the past decade. This advancement has been largely along lines of additional human comfort, both from the health standpoint and the control standpoint.

"First, let's consider solar heating. Advances have been made, much has been learned, and there is still considerable research being conducted on solar heating. The use of solar energy for house heating, domestic hot water heating, and other uses has been proved possible. Data obtained from experiments are of value in designing homes and other buildings with a view to utilizing solar heat in a practical way. However, the absorption and storage of solar heat for carryover is another problem and much research is being conducted along this line. The most important factor has not yet been solved; that is, how to design and install a solar system and be economical as compared with conventional heating systems.

Let's Consider the Heat Pump

"Now, let us consider the heat pump. We hear and read a great deal these days on utilizing the earth, air, wells, and lakes as heating sources. This year we heard about the largest heat pump installation in the United States, the Equitable building in Portland, Ore. This job obtains its heat from two wells. Electrical rates are relatively low in the Pacific Northwest and since it was planned to air condition the building completely, and air conditioning required cooling

capacity greater than the maximum heating demand, the heat pump was designed to handle both heating and cooling. Actual operating costs are not yet available; however, detailed operating cost estimates would justify this installation. Extensive metering and graphic instrumentation should reveal further data on operating costs in 1949.

"In general, the economic aspects of the heat pump seem to favor the commercial as compared to the residential installation in the near future. In the southern part of the United States, where the home owner is willing to pay for summer cooling as well as heating, the heat pump can be justified in the higher priced homes.

"Many other advances, while perhaps not as unusual as solar heating or the heat pump, have been made in the field of heating. We have radiant heating—hot water, electrical resistance, and warm air. Some engineers claim reduced heating costs with radiant heating. [I, personally, am quite interested in the electrical resistance method, generally buried in plaster or concrete. I have designed and observed several installations which are functioning very satisfactorily. With an electric system, we know what our operating efficiency is and we can with a minimum expenditure have an individual control and operating temperature for every room, be it a domestic or commercial installation. It must also be understood that we are operating under one of the lowest electrical rates in the United States.]

"We also have baseboard heating, which generally utilizes circulating hot water around the perimeter of the structure. Considerable improvement has been made in various types of radiation. We have convectors which are made in many styles, recessed and surface mounted, and which utilize convection currents to distribute the warm air.

"Last, but not least, we have our warm air jobs, both domestic and commercial. Improvements on both have been considerable — instrumentation, control, and air distribution and diffusion. Instrumentation and control have taken a lot of the manual control and guessing out of the job, the net result being less work, closer temperature differentials, and greater human comfort. Distribution and diffusion are two very important phases of a warm air job, tending to eliminate drafts, cold spots, hot spots, and in the final analysis are the gage by which the user judges the entire installation. Boilers and furnaces have and will continue to make improvements in the form of efficient operation, which to the user means more Btu's per dollar.

Ventilating and Air Conditioning

"We have already touched on ventilating and air conditioning along with heating, but this important field needs further discussion. The ASHVE Guide (which is the bible of the heating, ventilating, and air conditioning engineer) defines ventilation as the process of supplying or removing air, by natural or mechanical means, to or from any space. Such air may or may not have been conditioned.

"There have been many improvements in ventilating and air conditioning, of which we shall discuss but a few. Management has helped bring our field to the front, recognizing the problem of increased productivity can be helped through better employee relationship. The worker today is fortunate in working under improved health and comfort conditions provided by adequate ventilation and heating systems.

"When we design an air conditioning or ventilating system, the ultimate is to see and hear nothing and to feel nothing but body comfort. Considerable thought is given to acoustics, for the operating system should not reach an objectionable noise level. This can and is readily accomplished in a well designed system. It should move the desired quantity of supply and exhaust air with a minimum (or no objectionable feeling) of air movement, commonly called drafts. Present-day results from costly and extensive research have accomplished much in this direction.

"The air should be clean, at least to the point of no visible particles. This can readily be accomplished with ordinary attention to filtration. The visible particles are comparatively easy to handle with many types and makes of air filters. This filtering business is a very interesting and lengthy subject about which much has been published. I will endeavor to discuss only that which I believe will be of most interest to all. The greater part of atmospheric dust is invisible to the naked eye, but it is there at all times and in such quantities that are unbelievable, carrying many germs and causing much respiratory trouble. Smoke particles cause a lot of grief in the ventilating system.

"We are just now entering a brand new method of air cleaning, called sonic precipitation—which is ultrasonic energy or inaudible sound. It seems that the finer the particles, the easier they are coagulated to form aggregates by this sonic precipitation. Truly an interesting research, when one thinks in terms of acid mists, natural fog, and other fields upon which research is being conducted with gratifying results.

QUESTION OF THE MONTH

WANTS DATA ON RATINGS OF OLD STYLE RADIATORS

You are invited to answer the following question from "R.L.B.," member of a firm of architects and engineers. Suitable comment on this matter will be published, and paid for at regular rates (with additional payment for sketches). Address The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"We are in need of a source of information on ratings of old style, column type, cast iron radiators, or some method of determining their ratings.

"In remodelling work, we frequently come in contact with many variations of such radiators, for which we need to know the square foot radiation rating, and we are hard put to determine this. Any thoughts as to where or how we might obtain ratings for these radiators would be appreciated.

"We subscribe to Heating, Piping & Air Conditioning."
—R.L.B.

QUESTION OF THE MONTH

"In conclusion, a most important application related to the heating, ventilating, and air conditioning field is the sterilization of air by means of germicidal mists and vapors. We have all read something about air sterilization with glycol vapors. Many glycols have been studied. To quote F. R. Weaver, of Air Research Associates, from a paper given before the American Society of Mechanical Engineers, 'the ideal air sterilizing agent should be nontoxic, nonirritating to the respiratory tract and yet possess marked killing action on bacteria suspended in air, odorless, tasteless, relatively inexpensive, easily obtainable and the substance should not be corrosive or injurious to paper, fabrics, or other materials commonly used in treated spaces. Of all the compounds investigated, triethylene glycol is the only one which meets all the specifications.'

Beat the Cold Germ?

"It appears that the greatest step has been taken toward the elimination of the germs in the air about us. We know there are many bacteria and viruses, which frequently hit when our resistance is low and cause disease. If we beat only the cold germ we have accomplished a great deal.

"Perhaps these remarks will explain in part why my life is devoted to this very interesting field of heating, ventilating, and air conditioning."—W.B.P.

ACTIVATED CARBON FILTERS WILL PROTECT PAPER

This is in reply to the Question of the Month from "J.R.B.", published in the September HPAC, regarding the air conditioning of a few rooms containing valuable old records in order to prolong their life.

There are four causes which contribute to the impairment of paper manuscripts or prints. These are (1) the deterioration of the basic pulp stock from which the paper was originally made; (2) the action of light, especially sunlight; (3) the action of moisture and variation in the relative humidity of the air to which the papers are exposed; and (4) the acidic corrosion of the paper by airborne acids, particularly sulphurs, common to the air surrounding practically all populated communities.

The first of the above causes is obviously beyond control since the intrinsic durability of the paper is inherent in its original quality. The second can be controlled by storing the manuscripts in vaults or windowless rooms to protect them against exposure to bright daylight. The third cause, that of moisture, can be controlled by air conditioning the storage or exhibit space so as to maintain a constant relative humidity. I have no definite knowledge as to the percent of relative humidity most beneficial but believe 40 percent should be satisfactory. It should certainly be relatively low but, at the same time, not low enough to cause the paper to dry out and become brittle. The more important consideration should be to maintain the humidity constant.

The fourth cause contributing to the impairment of paper prints, manuscripts, etc., is the one with which I have had direct experience. It is, for example, the sulphur dioxide in ordinary air which is responsible for the yellowing of paper with age. This and similar minute concentrations of deleterious acids common to outdoor air can be effectively extracted with activated carbon filters. Many rare book and historical manuscript archives have adopted this protection, among them the Widener memorial library at Harvard, the Sterling library at Yale, the Denver museum, and others.

In order effectively to apply activated carbon protection, it is necessary for the air conditioning system to supply decontaminated air at a volume sufficient to pressurize the space against leakage under all conditions so as to prevent the infiltration of contaminated air. Assume, for example, that the calculated leakage or infiltration factor is 1000 cfm; then, at least that volume, preferably 1200 cfm, of outside air must be continuously supplied and decontaminated. The decontamination should consist of (1) adequate filtration to extract dust (if soot and smoke are anticipated, electrostatic precipitation should be used), and (2) activated carbon filtration to extract vaporous and gaseous impurities.

If the space is to be occupied, the chances are that greater total air circulation would be desirable than obtained by the outside air introduced only for pressurization. In that event, such excess air can be recirculated and, if advisable, also decontaminated.—H.S.

IBR HEARS REPORTS, ELECTS W. C. MURRAY

An extensive field training program to stimulate the sale of hot water and steam heating systems was authorized at the recent annual meeting of the Institute of Boiler and Radiator Manufacturers. More than 100 members and associate members from the U. S. and Canada attended the three-day affair, at which reports were presented on research, testing and rating of boilers, short courses, consumer advertising, publicity, and other activities pertaining to the interests of manufacturers of boilers, radiators, baseboard heating units, convectors, controls, and hot water and steam heating equipment and accessories.

Continued active demand for hot water and steam heating equipment is expected in 1949 and well into 1950, according to opinions of leading manufacturers who participated in an open forum discussion on current business conditions in the industry.

W. C. Murray, the president of the Utica Radiator Corp., was elected chairman of the institute; S. K. Smith, president of the H. B. Smith Co., was elected vice chairman; R. E. Ferry is general manager of the IBR, with offices at 60 E. 42nd St., New York 17.

Two More Installation Guides

Members were advised that two additional installation guides will be available after January 1, covering cast iron radiant baseboards and two pipe, reverse return, forced circulation, hot water heating systems.

M. W. McRae reported on proposed changes in the IBR rating code to include gas fired conversion boilers.

During a discussion of the problems of boiler inspection, it was disclosed that several engineering representatives of boiler manufacturers favor the inspection of all boilers in buildings which house six or more families.

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Practical Pointers on Using Cast Iron Sectional Boilers

Every once in awhile, Mr. Lewis devotes his "page" to a discussion of a type of equipment used in heating, piping, or air conditioning systems for plants and large buildings. In October, for example, he wrote on Scotch marine type boilers. This month, he comments briefly on cast iron sectional heating boilers

THERE ARE two general classes of sectional cast iron boilers—those having the various horizontal slabs stacked like pancakes one above the other, and those having the sections like a sliced loaf of bread, each behind or in front of the others.

The pancake type of boiler is almost always circular, the sections being connected by several nipples with their neighbors so that the water can circulate freely from bottom to top of the entire boiler through the different sections. These boilers usually are identified by the term "round."

In most of this type, each superimposed section is different from the section below it, so that the gases must meander around the various water-filled cross passages. The grate size is limited by the diameter of the firepot and the combustion chamber height generally bears a reasonably intelligent relation to the amount of fuel burned.

Round boilers therefore bear a good reputation for economy and dependability within the range of their relatively small capacities.

Possibly the boiler made by assembling a number of vertical sections was developed to serve systems too large for the round type of boiler. For such a boiler there must be a front end section with doors for cleaning and stoking, and there must be a back end section with a breeching opening. There is also a series of intermediate sections, each having a share in forming a combustion chamber—and more or fewer of these sections may be furnished as required by the output demand. The flexibility of such a design is thus apparent.

There may be several additional sections different in detail toward the rear of the boiler so as to assure a generous surface for transferring the heat from the products of combustion to the water. The sections, in actual practice, are complicated castings requiring pre-baked sand cores. In operation, the expansion and contraction strains in each casting are complex, since the upper part in the steam zone becomes much warmer than does the lower part that is water cooled.

Essentially an Assembly of Small Boilers

In some cast iron boilers, the sections are connected by short exterior right and left threaded nipples to three horizontal cast iron headers, one on each side near the bottom and the third above the sections on the center line. Thus, should a section break, it can be plugged off and the boiler as a whole may worry along without it at no great sacrifice.

In another type, the sections are connected each to the other by three push nipples, and there are no exterior headers.

The older sectional boilers—generally called "square" to identify them as different from the round type—essentially are an assembly of a group of smaller sep-

arate boilers, each having a water inlet at the bottom and a steam outlet at the top. There is no definite rapid circulation of water from section to section longitudinally along the sides of the combustion chamber.

Liberation of steam from the surface of the water in the relatively small cast iron tubes must create turmoil at the water line.

Each section receives heat at a different intensity than that received by its neighbor, influenced by its nearness to the hottest part of the fire.

A considerable difference in the height of the water line is shown if one installs a gage glass on each section of one of these boilers.

Modern square type boilers show evidence of appreciation, by their makers, of the advantages of uniform and comprehensive interior water circulation, since the top nipples have been increased in diameter and are so located that the water level in a steam boiler is about at the centers of the nipples. Thus the water can circulate freely from section to section, and the steam still can flow from section to section.

The manufacturers of the older boilers used to stipulate that the purchaser must build an exterior steam header of pipe and fittings and that he must connect most of the sections to this header.

Due to the differences in output between the sections, and possibly due to chemical reactions from poorly eliminated core sand, square type boilers may be "nervous" as to stability of the water level. They sometimes tend, when new, to prime and foam and often require persistent rewashing and doping with chemicals.

Boiler Ratings Now More Reliable

There was a period a few years ago during which manufacturers of sectional boilers published ratings that appeared to be somewhat extravagant. An engineer, in selecting a boiler, was often compelled to discount the published rating from 50 to 80 percent. Happily, due to the efforts of the Institute of Boiler and Radiator Manufacturers, and the cooperation of the Heating, Piping and Air Conditioning Contractors National Association, ratings for these boilers have been revised so that now, in general, engineers and contractors can use them with greater confidence. One remembers, however, the days when a sectional boiler was rated as so many square feet of radiation per section—the fact that the heat absorption per section varies widely in relation to the position of the section in the assembled boiler being blissfully ignored.

One also remembers boilers having the heat-absorbing surfaces so close above the grate that the coal could not be spread evenly or be thrown far enough to keep the grate area, most distant from the fire door, free from air holes.

Most birds, it is said, have to eat practically all the time in order to live, so primitive are their apparatuses for converting food to heat and energy. Some of the early cast iron sectional boilers similarly had so little heat absorbing surface in proportion to the grate area that when a hot fire was built, too much of the heat went up the chimney.

Covering Part of Grate

I have improved the operation of many sectional boilers by covering a considerable part of the original grate surface. Fairly prosperous businesses have flourished by installing in the combustion chambers of large sectional cast iron boilers additional copper heat absorbing and water circulating tubes. This operation might be said to compare with adding to a man's 30 ft length of small intestines an additional 10 ft or more to improve his ability to digest his "fuel"!

Fins on Building Cut Air Conditioning Load

An interesting architectural feature of Dunlop House (new three story laboratory and office structure now being built in Durban, South Africa) is the series of vertical fins in front of the windows on the western and eastern sides of the building to prevent direct sunlight from striking the glass, thus easing the load on the air conditioning system, according to Heman Greenwood, vice president in charge of Carrier Corp.'s international division. This method of construction has become very popular in Brazil and other countries where sunlight is a strong factor in the heat load.

C. A. Christiersen, general manager of Air Conditioning & Engineering Co., Ltd., who is making the installation, says that Dunlop House will be one of the most modern buildings in South Africa. The main office block will be completely air conditioned. The system is designed for three zones, with one common return fan. The installation calls for two "Freon 12" belt driven compressors, two evaporative condensers, and one centrifugal fan, in addition to the necessary auxiliary equipment.

Vertical fins on the western and eastern sides of Dunlop House, air conditioned building under construction in South Africa to house the offices and laboratories of Dunlop South Africa, Ltd., prevent direct sunlight from striking the glass, thus ease the load on the air conditioning system.

DATA SHEET

INSTRUCTIONS FOR OPERATING CENTRIFUGAL PUMPS

THE FOLLOWING instructions for operating centrifugal pumps have been reproduced by permission from the centrifugal pump section of the Standards of the Hydraulic Institute, copyright, 1948, by the Hydraulic Institute, New York. The original numbering of the paragraphs has been retained.

B-102. Priming. BEFORE STARTING THE PUMP, THE CASING AND SUCTION LINE MUST BE FILLED WITH WATER. The pump must not be run unless it is completely filled with water, as there is danger of injuring some of the parts of the pump which depend upon water for their lubrication. Wearing rings will not seize when the pump is filled with water but are very liable to do so when the pump is run dry. The pump may be primed by any of the following methods, as may be best suited to the conditions: PRIMING BY EJECTOR or EXHAUSTER. When steam, high pressure water, or compressed air is available, the pump may be primed by attaching an air ejector to the highest points in the pump casing. This will remove the air from the pump and suction line provided a tight valve is installed in the discharge line close to the pump. As soon as the ejector waste pipe throws water continuously, the pump may be started. After starting, a steady stream of water from the waste pipe indicates that the pump is primed. If this stream of water is not obtained, the pump must be stopped at once and the process of priming repeated. A foot valve is unnecessary when this kind of device is used

B-103. Priming by Foot Valve Only. When it is not practicable to prime by ejector or exhauster, the pump may be primed by the use of a foot valve. The foot valve will prevent water running out through the suction inlet and the pump can be completely filled with water from some outside source. Pet cocks on top of the pump should be opened during filling to allow the air to escape. A tight foot valve will keep the pump constantly primed, and so it may be used for automatic pump operation. It must be inspected frequently, however, to see that it does not develop leaks and thus allow the pump to be started dry.

B-104. Priming by Vacuum Pumps. When neither of the above methods of priming are practicable, the pump may be primed by the use of a vacuum pump to exhaust the air from the pump casing and suction line. A wet vacuum pump is preferable, as it will not be injured if water enters it. When a dry vacuum pump is to be used, the installation must be such as to prevent water being taken into the air pump. This may be done by having the pipe leading from the pump to the air pump installed with a vertical rise of over 35′.

CAREFUL ATTENTION TO THE PRIMING METHOD WHEN THE PUMP IS INSTALLED MAY SAVE ANNOYANCE LATER DUE TO IMPROPER PRIMING EQUIPMENT.

B-105. Starting. THE PUMP MUST NOT BE STARTED WITHOUT BEING PRIMED. Be sure that the driver rotates in the proper direction. This is usually indicated by a direction arrow on the pump casing.

B-106. A high or medium head centrifugal pump, when primed and operated at full speed with the discharge gate valve closed, requires much less power than when operating at its rated capacity and head with the discharge gate valve opened. For this reason, it is advantageous that the gate valve always be closed when the pump is being started, except as noted below. It is to be noted, however, that in general the lower the normal operating head, the less does the closing of the discharge gate valve affect the power required at normal capacity; until at extremely low heads such as for low head, large volume irrigation pumps, where the design approaches the mixed flow type of pump, the shut-off horsepower may equal or exceed the horsepower required with discharge valve open.

B-107. Pumps of the mixed flow type frequently require more horsepower with the discharge valve shut than with it open. Propeller type pumps nearly always require a great deal more power at shut-off than at rating and must be started with the discharge valve open. The manufacturer's instructions should be consulted for the characteristics of such pumps.

B-108. Reduced Voltage Starting. With smaller sizes of pumps with a squirrel cage induction motor, it is often permissible to start the motor on reduced voltage with the gate valve open, if the torque conditions of the motor permit such starting and no likelihood of injurious water hammer will occur when changing the motor over from the starting position to the running position.

With larger sizes of pumps using squirrel cage induction motors of the reduced voltage starting type, we recommend that the gate valve always be closed when the pump is being started, except as noted above.

B-109. Across the Line Starting. When using either small or large squirrel cage induction motors of the line starting type, it is permissible to have the gate valve open when the pump is being started. The length of time of the disturbance on the line, due to the starting condition, may be shortened, if the gate valve remains closed.

B-110. Synchronous Motors. Synchronous motors of the general purpose sizes up to and including 500 hp at 80% pf and 600 hp at unity pf, having speeds of 500 rpm or higher are designed with sufficient pull-in torque to start pumps with discharge valve open. Above these horsepower ratings and for speeds below 500 rpm, motors are not designed standard for sufficient pull-in torque to start pumps with discharge valve open. However, the comments given above for squirrel cage motors also apply to synchronous type.

B-111. Wound Rotor and Direct Current Motors. If the pump must be started with the discharge valve open and the starting current must be kept to a minimum, a wound rotor induction motor should be used, as this type of motor will develop full load torque without requiring excessive line currept; or, if direct current is available, a motor of the direct current type will also develop full load torque without taking line current exceeding 125 to 200% of normal full load current.

B-112. Stuffing Boxes. Do not draw glands tight. A slight flow of water from the stuffing boxes when pump is running keeps packing in good condition.

B-113. Wearing Rings. Wearing rings are fitted in the casing and usually on the impeller around the inlet to reduce the quantity of water leaking back from the high pressure side to the suction side. These wearing rings are fitted with a small clearance and depend on the water in the pump for lubrication. They will eventually wear so that the clearance becomes greater and more water passes back into the suction. The rate of wear depends on the character of the water pumped.

B-114. Stopping. Before stopping the pump, close gate valve. This will prevent water hammer on check valve.

LOCATING TROUBLE

B-115. No Water Delivered:

(a) Pump not primed.
‡(b) Speed too low.
(c) Discharge head too high.
(d) Suction lift higher than for which pump is designed.
(e) Impeller completely plugged up.
(f) Wrong direction of rotation.

B-116. Not Enough Water Delivered:

(a) Air leaks in suction or stuffing boxes.
‡(b) Speed too low.
(c) Discharge head higher than anticipated.
(d) Suction lift too high. Check with gages. Check for clogged suction line or screen.
(e) Impeller partially plugged up.
(f) Not enough suction head for hot water.
(g) Mechanical defects:
  (1) Wearing rings worn.
  (2) Impeller damaged.
  (3) Casing packing defective.
(h) Foot valve too small.
(i) Foot valve or suction opening not submerged deep enough.

B-117. Not Enough Pressure:

‡(a) Speed too low.
(b) Air in water.
(c) Mechanical defects.
  (1) Wearing rings worn.
  (2) Impeller damaged.
  (3) Casing packing defective.
(d) Impeller diameter too small.

‡When direct connected to electric motors, check up whether motor is across the line and receives full voltage. When direct connected to steam turbines, make sure that turbine receives full steam pressure.

B-118. Pump Works for a While and Then Loses Suction:

(a) Leaky suction line.
(b) Waterseal plugged.
(c) Suction lift too high.
(d) Air or gases in liquid.

B-119. Pump Takes Too Much Power:

(a) Speed too high.
(b) Head lower than rating, pumps too much water.
(c) Specific gravity or viscosity too high.
(d) Mechanical defects:
  (1) Shaft bent.
  (2) Rotating element binds.
  (3) Stuffing boxes too tight.
  (4) Wearing rings worn.
  (5) Casing packing defective.

WHY DOES OIL BURNER FLAME DIE DOWN?

A reader of HPAC asks the following question about oil burner operation:

"I have an oil burner which burns No. 6 oil. Will you please tell me what causes my flame to keep dying down?

"It seems that I can open the valve and there is plenty of oil there, and it will give a good flame for 10 or 15 minutes—then it gradually dies down. Sometimes it will go out."

Kalman Steiner, of C. Hoffberger Co., Baltimore, a member of HPAC's board of consulting and contributing editors, has prepared the following comments:

"The problem posed does not lend itself to a clearcut solution without the benefit of additional data. I can only suppose certain conditions to exist, and suggest that he confirm them.

"It would help immensely if we knew what vacuum prevailed in the suction line, and what pressure the pump developed, and whether the pump pressure were steady. I am setting up two sets of conditions, and suggesting a remedy for each.

"The more likely condition is that the suction line is partially blocked, either by a fouled strainer or some obstruction in the suction pipe. It is not current practice to use foot valves at the bottom of the suction stub, but if this job has one it should be removed immediately. A vacuum gage inserted in the suction line pretty well tells the story, although to give an accurate interpretation of the vacuum reading one would have to know the location of the tank with respect to the pump, the size of the suction line, and the capacity of the burner. It may be that the suction pipe is too small. At any rate, if a vacuum gage between the strainer and the tank shows a reading above 25 in., the chances are that the suction line is either partially blocked or is too small.

"The actual reading on the oil pressure gage is not too important, but it is very important to observe whether the reading fluctuates. If it does, it indicates a varying oil delivery (assuming the pressure regulator is in proper order), and would substantiate the conclusion regarding a partially blocked suction line.

"If my assumption of a blocked suction line is not sustained by subsequent investigation, then we must look for the trouble on the discharge side of the pump. I have already indicated that the pressure regulator must be in proper working order. If a weak spring is allowing the oil pressure to fall off, then of course the oil flow will diminish with the falling pressure.

"Assuming that the pressure regulator and suction line are both okay, the trouble might originate in the formation of a film or a deposition of sediment in the flow valve that governs the fire size. The remedy is to operate with the oil pressure as low as possible, thereby permitting the flow valve to be opened as wide as possible and overcome, so far as possible, the tendency to form film or deposit sediment at this point of constriction in the path of oil flow.

"There is one other possibility. This burner has perhaps a circulating loop, around which oil is bypassed in order to maintain circulation rapid enough to keep hot oil flowing to the atomizer. The amount of bypassed or recirculated oil is probably governed by an orifice or some similar device in the oil pressure line beyond the point of atomizer feed, located so as to bypass oil back into the suction line. If this bypass control is not passing a uniform quantity of oil, then of course the volume of feed to the atomizer can diminish. This is, however, rather a remote possibility.

"Without actually observing the burner operation, there is little else I can suggest from the information submitted."

"OPEN FOR DISCUSSION"

possible. It is further my understanding that the determination of

feed. The word implies a wate supply unfit for drinking—unpo able

"Open for Discussion"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago

Chilled Water Coil Selection for Air Conditioning Service

Certain assumptions are necessary in the selection of the right chilled water coil for air conditioning, and an article in the September HPAC, written from the viewpoint of the engineer, provided some general guiding values. An engineer who has had a wide experience in coil selection for process and comfort work comments on the problem this month

J. A. BISHOP's article in the September HPAC on Selecting Chilled Water Coils develops his concept of the relationship of the internal sensible heat ratio to coil sizing and the determination of water temperatures.

It also develops the relationship, when mechanically chilled water is used, of coil sizing to refrigeration machine operating conditions (suction temperature and kindred data) and how the proper integration of the various factors can affect the initial cost and operating cost of the various items of equipment used.

Mr. Bishop runs through one or two specimen calculations to determine the coil size and depth (number of rows) for various operating conditions and requirements.

Standard Rating Method Needed

I have done some work in calculating water coils and agree with Mr. Bishop that the actual capacity of the various water coils does not vary too much. One coil may have a different ratio of primary to secondary surface with a consequent smaller overall *U* coefficient, but makes up for it by having a greater area of total surface in a square foot of face area.

However, the method of calculating the total surface required does vary considerably, depending on whose calculations are used. Actual instances can be cited where one method of calculation indicated the use of a coil eight rows deep and another indicated 11 rows.

There will never be any uniformity in coil selection until a standard method of rating coils, with the dry and wetted surface computed separately, and with accurate values for the internal and external film coefficients of the coils, is adopted.

I do not follow Mr. Bishop's specimen calculation, as given in his article, to select a coil to meet a certain requirement. In sizing the coil, Mr. Bishop uses "data of a prominent coil manufacturer." These data employ the conventional method of using a sensible heat transfer rating with a multiplying factor to account for the latent work done.

This method gives satisfactory results when all or most of the coil is wetted, but is not safe to use when a considerable portion of the coil is dry. With the method employed, it is impossible to make an accurate computation of the work done by the wetted section, together with work done by the dry section, as the heat transfer of each is entirely different.

To handle his typical example, Mr. Bishop needs air at a condition something in the order of 59 deg—58 deg—57 deg, and with 56 deg entering water and a 10 deg water rise, a coil about 10 rows or more deep will be required. If it would be permissible to use more water, an eight row coil, double serpentine, with a temperature rise of around 6 deg would probably give the desired results. The lower water temperature rise will increase the mean

"OPEN FOR DISCUSSION"

temperature difference and most of the coil would be wetted. The double serpentine design would cut the water velocity about in half and keep the water pressure drop through the coil within reasonable limits.

Use of Coil Surface Temperature

A brief comment about the use of coil surface temperature may not be amiss. When one mentions surface temperature, the point where the surface temperature is taken must always be stated. For instance, is it at the air inlet side of the coil, in the middle, or at the air outlet side? The surface temperature, as is well known, varies widely through the depth of the coil. With constant air volume and constant entering water temperature and velocity, the surface temperature is a function of the entering air temperature at the point where it is taken. If the surface temperature at the last row of the coil section at the air outlet side is required, one must know the water temperature at this point and also the air temperature. The work of a coil cannot be computed by assuming a surface temperature at the air outlet side and using the air and water temperatures of the air inlet side.—F. F. Stevenson, engineer, Chicago.

GIVES BASIS OF COOLING COIL FORMULA

I have been asked the source of the equation given on page 85 of my article, Selecting Chilled Water Coils, published in the September HPAC. This equation reads as follows: $T_w = 2T_s - WB_t$, where T_w is entering water temperature, T_s is surface temperature, and WB_t is the wet bulb of the air leaving the coil.

This equation is based on published data of a manufacturer of coils, which data say that the surface temperature is the average of the entering water temperature and the final wet bulb temperature. That means that $T_s = (T_w + WB_t) \div 2$, which by transposition becomes the formula I used.

As I understand it, the determination of surface temperature on a rational basis with all the variables involved is quite difficult, if not impossible. It is further my understanding that the determination of surface temperature as used in the above equation was determined empirically from a great number of tests, and it was found from these tests that surface temperature in the sense in which it is used here could be correlated most closely with entering water temperature and leaving wet bulb temperature.

Possibly, in this connection, the choice of the term "surface temperature" is something less than ideal. What is meant by "surface temperature," as I understand the published data, is the temperature to which air with certain entering conditions would be cooled if it were cooled to complete saturation with a predetermined ratio of sensible to total heat extraction. This is the sense in which the term "surface temperature" was used in my article. —J. A. Bishop, district manager, American Blower Corp., Dallas.

SCOTCH BOILER NEEDS FURNACE EXTENSION

Samuel R. Lewis has presented what seems to me a fair summary of the background, nature, and virtues of the Scotch marine boiler in his article in the October HPAC. I have, however, some comments to make on the subject.

After pointing out the need for a Dutch oven for hand firing, Mr. Lewis states that mechanical firing needs none. To this statement I take exception.

Almost all oil burner manufacturers recommend some form of furnace extension, with refractory lining. Usually, the more careful the design of the Dutch oven, the more efficient the boiler performance. As to underfeed stokers, I know of only one manufacturer who attempts application to a Scotch, and that firm also makes the boiler. Spreader stokers can not possibly be applied to these boilers without a water-cooled Dutch oven.

"Scotch boilers . . . have the reputation of enduring water that is badly contaminated." "No one familiar with the difficulty in clearing mud and other debris from . . . a Scotch boiler will countenance contaminated feedwater." These two sentences from the article seem to be at variance.

"Contaminated" is an unforunate word to use in reference to boiler feed. The word implies a water supply unfit for drinking—unpotable. A crystal clear, sparkling, drinking water, highly prized as a municipal supply, can hardly be described as contaminated, yet it may be a very poor boiler feed. On the other hand, a polluted supply, totally unfit for drinking, may serve very well as boiler feed. The subject of boiler feedwater chemistry is so complex that it cannot possibly be summarized by such a word as "contaminated."

To state that a Scotch boiler has the reputation for enduring contaminated water seems to me to be an absurdity. A scaled tube in a Scotch will overheat or fail just as quickly and just as surely as in any other boiler operating under like conditions.

To develop a boiler horsepower with 5 sq ft of heating surface is not peculiar to the Scotch boiler. With adequate setting, any other form of firetube boiler (except the vertical) will give equal performance.

The tube of any firetube boiler is essentially a heat absorbing surface, but has the secondary function of reinforcing the boiler heads. To imply that this is a "part-time" duty is somewhat misleading. What boiler part takes over when the tubes are not on duty?—Kalman Steiner, C. Hoffberger Co., Baltimore. Member of HPAC's board of consulting and contributing editors.

STEAM ENGINES USED AS REDUCING VALVES

We agree with the information given about steam engines in the article entitled Steam Drives for Refrigeration Improve the Plant Heat Balance, by Terry Mitchell, published in the October HPAC.

It might be well to point out that in the past year or so there has been much interest shown in "byproduct power," or the method of using a steam engine as a reducing valve for the production of low pressure process steam and thereby producing cheap power as a byproduct. As fuel costs continue to increase, we look forward to an increased use of steam drives of this type. In many cases, the steam engine provides the ideal type of drive because of its constant torque characteristics over a wide speed range.—R. S. Stuckless, Troy Engine & Machine Co., Troy, Pa.

UNIVERSITY OF MICHIGAN LIBRARIES

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

You Must Come to Chicago in January

C. M. Burnam, Jr.
President
Illinois Chapter

W. A. Kuechenberg
General Chairman
Committee on Arrangements

J. H. Milliken
Vice Chairman
Committee on Arrangements

All signs point to the Society's largest gathering when the 55th Annual Meeting of the ASHVE convenes in the Hotel Stevens, Chicago, Ill., on January 24, 1949.

An excellent technical program has been prepared by the Program and Papers Committee and Chairman A. E. Stacey, Jr., announces that five sessions will be held and the subjects of discussion will cover heat transmission, air distribution, radiant heating, chimney performance and physiological studies.

Pres. G. L. Tuve will call the first session to order on Monday, January 24, and the reports of Officers and the Committees will be received. Immediately following the session, a Welcome Luncheon for both the men and the ladies will be held. The speaker will be Dr. Henry T. Heald, president of Illinois Institute of Technology, and the Honorable Martin J. Kennelly, mayor of Chicago, will present a message of welcome from the city.

At the luncheon on Tuesday, Cyril Tasker, director of research of the ASHVE, will report on his trip to England.

At 2:00 p.m. on Monday, the 9th International Heating, Ventilating and Air Conditioning Exposition will be opened at the International Amphitheatre.

To supplement the technical sessions, W. A. Kuechenberg, general chairman of the Committee on Arrangements, states that a number of inspection trips will be available for visiting members, among which are the College of Medicine of the University of Illinois, where cooperative research with the Society is in progress, and the plants of several manufacturers, including Ilg Electric Ventilating Co., McDonnell & Miller, Inc., as well as the Sears, Roebuck & Co. laboratories.

The entertainment program has been prepared under the direction of the Illinois Chapter Committee on Arrangements and members will receive, by mail, a list of the special events and the ladies' program.

There will be an opportunity to make advance reservations for the two luncheons on Monday and Tuesday, the Monday night party and the Annual Banquet. The

COMMITTEE ON ARRANGEMENTS

General Chairman—William A. Kuechenberg. *Vice Chairman*—James H. Milliken. *Honorary Chairmen*—Harry M. Hart, E. Vernon Hill, John Howatt, Samuel R. Lewis, A. C. Willard.

Banquet Committee—Harvey G. Chapin, *Chairman*, Manuel J. Bamond, *Co-Chairman*, C. H. Bevington, Charles W. De Land, Harry Himelblau, Wm. G. Hoskins, Charles R. Kuglin, Eugene Mathis, Orville Miller, Jr., Ralph A. Patterson, J. J. Philippi, S. I. Rottmayer, D. B. Scheidecker, John F. Tobin, Mel. J. Stevenson.

Entertainment Committee—Joseph S. Kearney, *Chairman*, W. H. Brackett, A. L. Crump, Matthew J. Fitzgerald, E. P. Heckel, Jr., A. O. May, Lawrence O. Paul, Leo J. Potvin, Chas. E. Price, Earl E. Sundeen, Harvey G. Swart.

Exposition Committee—George W. Bornquist, *Chairman*, Clarence C. Graves, A. Warren Lippitt, Robert V. Mehaffey.

Finance Committee— Peter J. Marschall, *Chairman*, Wm. F. Christmann, Harry E. Clo.

Ladies' Committee—Mrs. William A. Kuechenberg, *Chairman*, Mrs. Chas. E. Price, *Secretary*, Mrs. Manuel J. Bamond, Mrs. M. W. Bishop, Mrs. George W. Bornquist, Mrs. C. M. Burnham, Jr., Mrs. Harvey G. Chapin, Mrs. Joseph S. Kearney, Mrs. Peter J. Marschall, Mrs. James H. Milliken.

Publicity Committee—Oliver J. Prentice, *Chairman*, W. W. Gothard, Morley M. Hattis, Thomas V. Johnson, Geo. G. Turner.

Reception Committee—M. W. Bishop, *Chairman*, A. S. Ammerman, Jr., Harvey E. Anderson, Byron L. Casey, George B. Coffey, Henry J. Couch, Thomas Cranage, Chas. E. Crone, J. F. Cummiskey, E. B. Ericsson, James J. Hayes, Carl W. Johnson, Walter W. Lige, Albert B. Martin, James C. Matchett, James E. McClellan, E. N. McDonnell, Edward M. Mittendorff, Roy O. Nelson, H. J. Prebensen, Walter A. Stahl, Arthur G. Stout, Nils W. Swanson, M. J. Van Weelden.

Sessions Committee—George V. Zintel, *Chairman*, Russell H. Burgess, John H. Clarke, G. Gill Freyder, Harry G. Gragg, Herbert Kreisman, James W. Muessig, Roy W. Shields, Roland M. Spencer, Louis H. Streb, Conrad M. Vreuls, Vernon L. Wesby.

banquet speaker will be Dr. Clark G. Kuebler, president of Ripon College; John Howatt will be the toastmaster.

Commencing on January 22, there will be a series of Committee Meetings each day. These will include the Council, Committee on Research, Admission and Advancement, the Guide Publication Committee, Chapter Delegates, Nominating Committee and a number of Research Technical Advisory Committees, currently numbering 16.

Members from all parts of the country are looking forward to five full days of business and pleasure in Chicago in January.

Advisory Committee Appointed

Pres. G. L. Tuve, of the ASHVE, is chairman of the Advisory Committee for the 9th International Heating and Ventilating Exposition. The newly appointed Advisory Committee of 33 members includes representation of 17 associations in such allied fields as acoustics, architecture, air filtration, insulation, fuels and others.

Membership of the Advisory Committee includes the following:

A. E. Stacey, Jr., 1st vice president, ASHVE; Lester T. Avery, 2nd vice president, ASHVE; M. W. Bishop, council member, ASHVE; L. N. Hunter, chairman, Committee on Research, ASHVE; H. M. Hart, past pres., ASHVE; E. Vernon Hill, past pres., ASHVE;

Railroad Rates

Chapter and Council Cities

	Round Trip Rail Fare	Lower Berth One Way	
Atlanta, Ga.	$ 45.65	$ 7.20	
Berkeley, Calif.	114.25	18.25	
Boston, Mass.	75.34	8.65	
Buffalo, N. Y.	39.20	5.05	
Chicago, Ill.	.....	.....	
Cincinnati, Ohio	22.95	3.50	
Cleveland, Ohio	26.35	3.50	
College Station, Tex.	64.70	10.40	
Columbus, Ohio	24.00	3.50	
Dallas, Tex.	55.70	8.90	
Denver, Colo.	60.40	9.25	
Des Moines, Ia.	20.90	3.50	
Detroit, Mich.	22.20	3.50	
Durham, N. C.	72.35	8.35	
Durham, N. H.	80.42	8.65	(fr. Boston)
Grand Rapids, Mich.	14.82	3.50	
Houston, Tex.	64.70	10.40	
Indianapolis, Ind.	14.82	3.50	
Ithaca, N. Y.	48.65	5.35	
Johnstown, Pa.	40.55	5.05	
Kalamazoo, Mich.	11.34	3.50	
Kansas City, Mo.	26.80	4.10	
Lafayette, Ind.	9.60	3.50	
Los Angeles, Calif.	114.25	18.25	
Memphis, Tenn.	31.80	5.05	
Milwaukee, Wis.	5.00	.80	(Seat)
Minneapolis, Minn.	23.75	3.50	

	Round Trip Rail-Fare	Lower Berth One Way	
Montreal, Que., Canada	57.10	7.75	
New Haven, Conn.	71.22	7.75	(from N.Y. only)
New Orleans, La.	54.85	8.65	
New York, N. Y.	65.40	7.75	
Norfolk, Va.	34.00	8.65	
Oklahoma City, Okla.	46.80	7.20	
Omaha, Nebr.	29.05	4.10	
Philadelphia, Pa.	58.95	7.20	
Pittsburgh, Pa.	35.40	4.10	
Portland, Ore.	114.25	18.25	
Raleigh, N. C.	72.55	8.90	
St. Paul, Minn.	23.15	3.50	
Salt Lake City, Utah	87.10	12.60	
San Antonio, Tex.	71.00	11.15	
San Francisco, Calif.	114.25	18.25	
Seattle, Wash.	114.25	18.25	
Shreveport, La.	50.10	8.35	
St. Louis, Mo.	17.05	3.50	
Syracuse, N. Y.	48.90	5.70	
Toronto, Ont., Canada	36.40	5.05	
Tulsa, Okla.	41.25	7.20	
Washington, D. C.	55.20	7.20	
Winnipeg, Man., Canada	48.50	7.20	

*Fifteen percent Federal Transportation Tax should be added to all fares and pullman rates.

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PROGRAM—55th ANNUAL MEETING

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Stevens Hotel **Chicago, Ill.**

Saturday—January 22

10:00 a.m. Committee on Research Meeting

Sunday—January 23

10:30 a.m. Council Meeting

1:30 p.m. REGISTRATION

4:00 p.m. Chapter Delegates Meeting

Monday—January 24

8:30 a.m. REGISTRATION

9:30 a.m. BUSINESS SESSION
- Greetings
- Reports of Officers and Council Committees

12:15 p.m. Welcome Luncheon—Speaker: Dr. Henry T. Heald, president, Illinois Institute of Technology

1:30 p.m. Chapter Delegates Meeting

9:00 p.m. Informal Party

Tuesday—January 25

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION
- Report of Tellers of Election
- The Internal Performance of an Induced Draft, Packed Cooling Tower, by N. W. Snyder
- Heat Transfer Rates for Freon-12 Boiling in Horizontal Tube Evaporators, by L. G. Seigel, W. L. Bryan and M. C. Huppert

12:30 p.m. Luncheon Meeting—Speaker: Cyril Tasker, Director of Research, ASHVE

6:30 p.m. Past Presidents' Dinner

9:30 p.m. Chapter Delegates Meeting

Wednesday—January 26

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION
- Are Automatic Air Shutters Justified on a Gas-Fired Conversion Burner? by W. M. Myler, Jr., and H. W. Nelson
- Performance of Fourteen Masonry Chimneys Under Steady State Conditions, by P. R. Achenbach and S. D. Cole
- Performance of Residential Chimneys, by L. B. Schmitt and R. B. Engdahl

2:00 p.m. TECHNICAL SESSION
- Performance of an Electrical System of Panel Heating with Four Stages of Insulation, by R. J. Lorenzi and J. F. Schreiber
- Heating A Basementless House With Radiant Baseboard, by R. H. Weigel and W. S. Harris
- Overall Coefficients for Flat Glass, Determined under Natural Weather Conditions, by G. V. Parmelee and W. W. Aubele

7:00 p.m. Annual Banquet—Toastmaster: John Howatt, past-president, ASHVE. Speaker: Dr. Clark G. Kuebler, president, Ripon College

Thursday—January 27

9:00 a.m. REGISTRATION

10:00 a.m. TECHNICAL SESSION
- Turbulence—A Fundamental Frontier in Air Distribution, by H. B. Nottage
- Adjustment and Balancing of the Air Delivery Through a System of Manifold Diffusers, by G. S. Dauphinee and Peter Argentieri
- Air Distribution and Draft, by John Rydberg and Per Norback
- Unfinished Business
- New Business
- Resolutions
- Installation of Officers
- Adjournment

12:30 p.m. Nominating Committee Luncheon

1:00 p.m. Council Luncheon Meeting

Method of Choosing Location of, Financing and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.

2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, not exceeding $500.00, the regular meeting expense to be taken care of by the General Fund of the Society in the regular way.

3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.

4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.

5—That the grouping of features and the sale of tickets for group features be discouraged.

6—That the raising of funds from manufacturers of heating apparatus be discouraged.

7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.

8—That the distribution of trade papers be entirely at the discretion of the committee in charge.

9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., and that this General Committee be requested to confer frequently with the Council, through the Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.

10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1926

The Stevens Hotel, scene of the 55th Annual Meeting faces the lakefront and Chicago's Michigan Ave.

John Howatt, past pres., ASHVE; Samuel R. Lewis, past pres., ASHVE; C. M. Burnam, Jr., pres., Illinois Chapter, ASHVE; W. A. Kuechenburg, general chairman, 55th Annual Meeting; J. H. Milliken, vice chairman; F. P. Keeney; E. N. McDonnell; Oliver J. Prentice and K. C. Richmond, Chicago.

R. H. Bolt, pres.-elect, *Acoustical Society of America;* George S. Jones, Jr., pres., *Air Conditioning and Refrigerating Ass'n.;* Howard W. Pound, *Air Filter Institute;* Douglas W. Orr, pres., *American Institute of Architects;* A. J. Schwantes, pres., *American Society of Agricultural Engineers;* B. H. Jennings, vice-pres., *American Society of Refrigerating Engineers;* Dr. R. C. Johnson, Pres., *Anthracite Institute;* J. B. Morrow, pres., *Bituminous Coal Research;* Thomas L. Eagan, pres., *Heating, Piping & Air Conditioning Contractors National Association;* R. E. Ferry, gen. mgr., *Institute of Boiler and Radiator Manufacturers;* J. V. Jones, pres., *Insulation Board Institute;* R. A. Wasson, pres., *National Association of Fan Manufacturers;* J. Z. Hollmann, pres., *National Mineral Wool Association;* Atlee Wise, pres., *National Warm Air Heating & Air Conditioning Association;* R. S. Bohn, pres.,*Oil-Heat Institute of America;* R. A. Locke, pres., *Steel Boiler Institute:* Claude A. Potts, pres., *Stoker Manufacturers Association.*

Exposition

Applications of heating, ventilating and air conditioning to industrial purposes are steadily increasing, as manufacturing requirements become more exacting, and many advances in specific equipment for such uses will be featured at the *9th International Heating and Ventilating Exposition,* sponsored by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, which will be held at the International Amphitheatre, Chicago, January 24-28.

Among novel uses of direct-fired space heaters, featured by one exhibitor, are the defrosting of diesel locomotive trucks in winter, tempering make-up air in a plant where paint spray and testing operations require a heavy exhaust of noxious fumes, and in a third plant, heating air for curing and drying purposes.

There have been many recent improvements in air handling equipment, such as the provision of adjustable blade pitch in industrial fan design. There will be one display of fans ranging in sizes from 12 in. to 48 in. in diameter, incorporating adjustable panel window fans, portable fans, etc.

Air purification by various means, notably by filtration, continues to engage the attention of equipment manufacturers and will account for a number of important displays, especially those covering institutional and domestic applications. One of the most comprehensive displays in this line will include 11 different types of dry filtering media, together with an assortment of frames in which these materials may be used; two designs of cleaners in which mechanical filtration and electric precipitation are combined. There will be at least one new washable air filter on view at the Exposition, while a manufacturer of electric air cleaners for residential, commercial and industrial applications will show new models for the first time.

For many uses the treatment of air by filtration through activated carbon affords health protection, in addition to comfort. An exhibition of this method will prove interesting to many visitors.

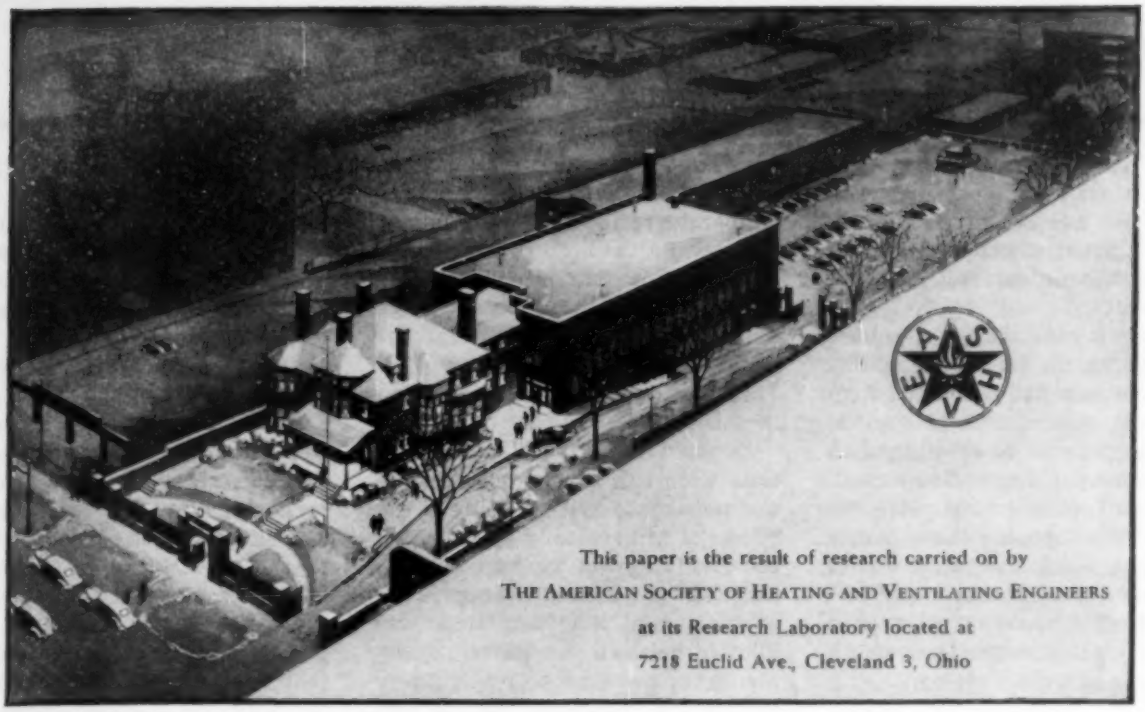
Air cooling systems will be exhibited in many forms, ranging upwards from a newly designed room cooler of distinctive design, that will be shown for the first time. Attention will be drawn by a roof cooling system which has been improved by the adoption of a new type of self-cleaning sprinkler head.

Many new features will be exhibited in the line of boilers and furnaces, including one new design which is said to be the first to be completely die stamped and mass produced along the lines of automotive equipment. Included among the many exhibits of burners will be one replacement unit which, by a simple adaptation, can be adjusted to fire from ¾ to 4.5 gal per hr of oil.

A number of exhibitors are pressing forward in floor and panel heating, radiant baseboards, control equipment and special equipment.

Like previous expositions, the *9th International Heating and Ventilating Exposition* will be open only to invited and registered visitors, and will be conducted under the management of the International Exposition Co., C. F. Roth, manager; E. K. Stevens, associate manager.

International Amphitheatre


This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Overall Coefficients for Flat Glass Determined Under Natural Weather Conditions

By George V. Parmelee*, and Warren W. Aubele**, Cleveland, Ohio

SUMMARY—Data are given for tests made under natural weather conditions on single sheets of glass and on two sheets spaced ¼ in. apart. Tests were made with the glass exposed to wind velocities of from 3 to 9 mph and with the glass sheltered from the wind. Surface conductances have been analyzed and show the separate influence of convection and radiation, the latter including nocturnal radiation effects. Comparisons are made with guarded hot box test data.

AN experimental investigation of heat flow through windows and glass block panels has been carried on for the past several years at the ASHVE Research Laboratory under the direction of the Committee on Research and the Technical Advisory Committee on Heat Flow Through Glass.† Although the major part of this study has dealt with the transmittance of solar energy, a limited study has been made of overall coefficients of heat transfer for glass under natural weather conditions to assist in interpreting solar heat gain data.

Although the tests made covered a narrow range of conditions, it is believed that the results are important enough to be reported and discussed at this time. Data are given for tests made on single sheets of glass and on two sheets spaced ¼ in. apart. Wind velocities ranged from 3 to 9 mph and in several tests the glass was sheltered from the wind. Experimental data on the convection conductances for the indoor surface of the glass are given. The convection and radiation components of the outdoor surface conductance have been computed. Comparisons are made with recent guarded hot box tests.

* Research Associate, ASHVE Research Laboratory. Member of ASHVE.

** Assistant Research Engineer, ASHVE Research Laboratory.

† TAC on Heat Flow Through Glass: R. A. Miller, *chairman;* A. B. Algren, A. H. Baker, F. L. Bishop, Jr., J. E. Frazier, J. S. Herbert, E. H. Hobbie, L. K. Jones, C. O. Mackey, F. W. Preston, W. C. Randall, C. A. Richardson, Vic Sanders, H. B. Vincent, G. B. Watkins, F. C. Wood.

For presentation at the 55th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Chicago, Ill., January 1949.

Apparatus

The apparatus used in the determination of the overall coefficients was a calibrated calorimeter which is being used in studies of solar heat gain through glass areas. Since it has been previously described,[1] only brief mention of its principal features will be made here. The calorimeter consists of a heavily-insulated blackened sheet-aluminum half-cylindrical shell to which is brazed a grid of tubes. Heat is supplied (or removed) by circulating a mixture of water and ethylene glycol through these tubes. Their arrangement and spacing is such that the calorimeter surface temperature at any point is within 1 deg of the average. This shell is bolted to the rear face of a window frame capable of being tilted through 90 deg and of orientation to any point of the compass.

A 2-ft wide border of plywood is fastened around the front face of the frame so that the test area occupies the central portion of an 8-ft square wall. The apparatus, in posi-

[1] Exponent numerals refer to Bibliography.

tion for solar transmittance studies, has been shown previously.[1] The calorimeter was sealed to prevent air infiltration and contained a desiccant to control moisture migration.

Sheets of glass 48½ in. square were set into the front face of this frame and fastened to a wood strip or stop with screws. This stop allowed the glass to be set flush with the plywood panel or to be recessed. The clear opening was 44½ in. square. The opening was double glazed by spacing the two sheets of glass with a continuous quarter-inch strip of plywood. The air space so formed was also provided with a desiccant and tightly sealed.

Results Obtained

The results of the tests appear in Tables 1 and 2. They apply to smooth flat glass surfaces and not necessarily to actual windows. The overall coefficients of heat transmission (*U* values) have been based upon the difference between the temperatures of the calorimeter surface and the outdoor air and on the heat flow determined by computation of the radiation exchange and the convection heat transfer from the calorimeter to the glass. This procedure is discussed later on in this report.

As noted in the tables some of the tests were run at night, so that it was possible to make a study of the effects of wind velocity by adjusting the orientation of the apparatus to maintain the desired average angle of incidence. Sufficient time was allowed between successive adjustments for the glass to reach a new equilibrium condition within the limits imposed by variable weather conditions.

To supplement the heat transfer data, temperature surveys of the glass surface were made with a 30 gage wire thermocouple probe. The junction and 1½ in. of each lead wire were fastened to a strip of felt ⅜ by 1½ in. in size and backed up by a pivotable wooden pressure shoe of the same size. Fig. 1 shows the results of two of these surveys. They indicate that wind velocity has a significant effect on local rates of heat flow. For parallel flow of air past a smooth heated surface, it is well known that the local convection coefficients decrease in the direction of flow. The combination of this effect with the natural circulation of air inside the calorimeter is believed to account for the temperature distribution illustrated. Computations of local radiant and convection heat transfer based upon temperatures as shown indicate approximately a 10 Btu per (hr) (sq ft) difference in heat flow between the upper left and lower right corners of the glass for the temperature pattern shown in the left hand illustration of Fig. 1.

Table 1—Overall Coefficients of Heat Transmission for a Single Sheet of Double Strength (⅛ In.) Glass

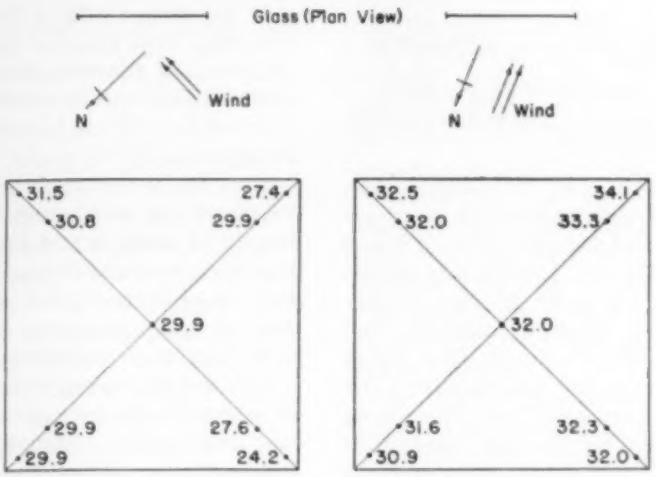
Date of Test	Time EST	Wind Velocity mph	Wind Incident Angle, deg	Sky[a] Condition	Temperatures, F Degrees Calorimeter Surface	Calorimeter Air[c]	Glass Indoor Side	Outdoor Air	Heat Flow Btu per (hr) (sq ft)	*U* Btu per (hr) (sq ft) (F deg)
1-20-48	7:15-8:00 p.m.	4.7	0	T.O.	73.8	72.1	46.2	36.2	35.1	0.93
1-20-48	8:15-9:15 p.m.	6.3	0	Clear	73.8	72.0	45.3	35.9	36.6	0.97
1-20-48	9:45-10:45 p.m.	5.7	0	T.O.	73.8	72.0	46.0	35.8	35.7	0.94
1-20, 21	11:45 p.m.-12:45 a.m.	6.1	45	T.O.	74.2	72.6	46.9	37.4	34.8	0.95
1-21-48	1:15-2:15 a.m.	5.3	Sheltered[b]	T.O.	74.5	73.0	48.7	37.6	32.8	0.89
1-21-48	3:15-4:00 a.m.	6.0	Sheltered[b]	T.O.	74.3	72.7	47.1	36.4	34.8	0.92
1-21-48	4:45-5:30 a.m.	4.7	Sheltered[b]	0.5C	74.3	72.8	47.3	35.7	34.3	0.89
1-21-48	Avg	5.7	0-45	T.O.	73.9	72.2	46.1	36.3	35.5	0.95
1-21-48	Avg	5.3	Sheltered[b]	T.O.	73.4	72.8	47.7	36.5	33.9	0.92
1-23-48	1:45-2:30 p.m.	5.0	45	0.5C	72.8	70.2	32.3	11.2	53.3	0.87
1-23-48	2:45-3:30 p.m.	4.3	0	0.6C	72.8	70.3	32.0	12.0	53.8	0.89
1-23-48	3:34-4:15 p.m.	3.3	20	0.5C	73.0	70.6	33.0	12.7	51.9	0.86
1-23-48	Avg	4.2	0-45	0.5C	72.9	70.4	32.4	11.9	53.0	0.87
1-26-48	2:00-2:45 p.m.	5.7	90	T.H.	76.9	74.4	38.6	24.2	49.8	0.95
1-26-48	3:00-3:45 p.m.	7.9	90	T.H.	76.8	74.2	39.1	23.8	48.9	0.92
1-26-48	Avg	6.8	90	T.H.	76.9	74.3	38.9	24.0	49.5	0.94

[a] Code: T.O., Thin Overcast; 0.5C, 0.5 Cloudiness, etc.; T.H., Thick Haze.
[b] Calorimeter rotated so that glass was in the lee of the wind.
[c] In a plane 18 in. from glass.

Table 2—Overall Coefficients of Heat Transmission for Two Sheets of ¼ In. Plate Glass with ¼ In. Air Space

Time[a] EST	Wind Velocity mph	Wind Incident Angle, deg	Sky[b] Condition	Temperatures, F Degrees Calorimeter Surface	Calorimeter Air[d]	Inner Glass Indoor Side	Inner Glass Outdoor Side	Outer Glass Indoor Side	Outer Glass Outdoor Side	Outdoor Air	Heat Flow Btu per (hr) (sq ft)	*U* Btu per (hr) (sq ft) (F deg)
9:45-10:30 p.m.	4.0	Sheltered[c]	O.C.	77.1	76.1	58.9	58.1	42.5	41.9	36.1	22.1	0.54
8:00-9:00 p.m.	6.8	0	O.C.	71.3	70.0	52.4	51.3	36.5	35.3	31.7	22.4	0.57
9:30-10:15 p.m.	7.7	90	O.C.	71.0	69.9	51.5	50.7	35.0	33.7	32.0	23.1	0.59
11:30 p.m.-12:30 a.m.	8.3	0	T.O.	71.5	70.8	52.3	51.7	36.5	35.2	32.6	22.6	0.58
1:15-2:15 a.m.	7.3	Sheltered[c]	0.8C	71.5	70.2	51.5	50.7	34.6	33.0	30.1	24.0	0.58
2:30-3:30 a.m.	8.2	0	O.C.	71.3	70.1	51.2	49.9	34.3	32.5	30.6	23.9	0.59
4:00-4:45 a.m.	8.8	90	O.C.	71.3	69.9	50.7	49.5	33.5	31.7	30.1	24.7	0.60
5:00-6:00 a.m.	8.8	90	0.8C	71.2	69.9	50.4	49.1	32.7	31.0	29.2	25.0	0.60
6:45-7:30 a.m.	9.0	Sheltered[c]	0.5C	71.0	69.9	49.9	48.5	32.0	30.9	27.6	25.4	0.59
Avg	8.1	0-90	O.C.	71.2	70.1	51.4	50.3	34.8	33.2	31.0	23.6	0.59
Avg	8.2	Sheltered[c]	0.7C	71.3	70.1	50.7	49.6	33.3	31.9	28.9	24.7	0.58

[a] All Tests except the first made on November 25-26, 1947; first test made November 17, 1947.
[b] Code: O.C., Overcast; T.O., Thin Overcast; 0.8C, 0.8 Cloudiness, etc.
[c] Calorimeter rotated so that glass was in the lee of the wind.
[d] In a plane 18 in. from glass.



Temperature Distribution

2:15 p.m.	Time (E.S.T.)	4:15 p.m.
72.7	Calorimeter Temp, Deg F	73.1
11.1	Outside Air Temp, Deg F	12.2
29.2	Mean Glass Temp, Deg F	32.2
5.5	Wind Velocity, mph	3.4

Fig. 1—Temperature distribution for a single sheet of glass (January 23, 1948)

Computation of Results

The Overall Coefficients of Heat Transmission

The overall coefficient of heat transmission, U, as it is used for computing heat losses or gains through buildings, is defined[2] as the time rate of heat flow in Btu per (hr) (sq ft) (Fahrenheit degree temperature difference between air on the inside and air on the outside of a wall, floor, roof or ceiling). The heat flow, q, in Btu per (hr) (sq ft) then is:

$$q = U\ (t_i - t_o) \quad \ldots\ldots\ldots\ldots (1)$$

where

t_i = indoor air temperature, Fahrenheit degrees.

t_o = outdoor air temperature, Fahrenheit degrees.

The heat flow, q, may also be determined by the following equation:

$$q = q_{ci} + q_{ri} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

where

q_{ci} = the heat transferred by convection, Btu per (hour) (square foot), to the indoor surface from the air in contact with it.

q_{ri} = the net exchange by radiation, Btu per (hour) (square foot) between the indoor surface and the surrounding solid surfaces or gaseous bodies which may be capable of emitting and absorbing radiation.

The overall coefficient may also be defined in terms of resistances. For a single sheet of glass, the resistance equation is

$$\frac{1}{U} = R_t = \frac{1}{h_o} + \frac{L}{k} + \frac{1}{h_i} \quad \ldots\ldots (3)$$

where

U = overall coefficient of heat transmission, Btu per (hour) (square foot) (Fahrenheit degree).

R_t = total resistance, (Fahrenheit degrees) (square foot) (hour) per Btu.

h = the surface conductance for convection and radiation combined, Btu per (hour) (square foot) (Fahrenheit degree); subscripts $_i$ and $_o$ refer to indoor and outdoor surfaces.

L = glass thickness, feet.

k = thermal conductivity of glass, Btu per (hour) square foot) (Fahrenheit degree per foot).

To determine U experimentally, q, t_i and t_o are carefully measured and then substituted in Equation 1. In hot box tests heat is usually supplied electrically so that q is determined from the heat equivalent of the electrical input to the guarded area. In the calorimeter apparatus q was found from separate determinations of q_{ci} and q_{ri} in Equation 2. In applying Equation 1 to the experimental determination of U values some practical difficulties arise. In an airtight enclosure, such as a guarded hot box or the calorimeter apparatus, the average temperature of the air is dependent upon the temperatures of the surrounding solid surfaces and their respective convection conductances. If there is no artificial air movement, natural convection currents cause the air temperature to vary from point to point throughout the enclosure.

In hot box tests heat flow is maintained by heating the air in the guarded space and by cooling the air on the cold side. Considerable stratification results, thereby leading to difficulty in determining the average air temperature unless it is measured at a large number of points. To avoid this, fans are usually provided to stir the air enough to avoid excessive stratification. It should be noted, however, that because radiant heat exchange between the test panel surfaces and the box surfaces takes place independently of the convection effects, the temperature of the box surfaces‡ necessarily is below the ambient air temperature on the warm side and above it on the cold side by amounts dependent upon the air movement, the surface emissivities, and the surface areas involved.

In the calorimeter apparatus the air temperatures were measured 18 in. from the test panel, as noted in Tables 1 and 2, and also by two shielded couples 4 in. from the glass. At 18 in. air temperatures were 1.0 to 2.5 deg below and at 4 in. 2.0 to 5.5 deg below the calorimeter surface temperature. Because of this variation with position and because the heat was supplied via the calorimeter surface, the overall coefficients listed in Tables 1 and 2 have been based upon the difference between the outdoor air temperature and the calorimeter surface temperature.

‡ The authors are unaware of data in the literature to prove this point.

Computation of Heat Flow

Considerable care has been taken to define the convection and radiation conditions which govern the heat exchange between the calorimeter surface and the indoor surface of a glass sheet as installed in the apparatus. This makes it possible to compare the results with other tests and to adapt them to practical everyday surroundings. And because these conditions are known for this apparatus, heat flow through the glass has been determined by simple computations from two test observations, namely, the average temperature of the calorimeter surface and the average temperature of the indoor surface of the glass. Heat balance computations afford an independent check.

Heat flow through the glass has been determined in accordance with Equation 2. Radiation was computed from the Stefan-Boltzmann law as follows:

$$q_r = F_s F_e\, 0.173\left[\left(\frac{T_c}{100}\right)^4 - \left(\frac{T_g}{100}\right)^4\right] \quad \ldots\ldots (4)$$

where

q_r = net heat exchange by radiation, Btu per (hour) (square foot).

F_s = the shape factor, glass with respect to calorimeter surface.

F_e = the emissivity factor, glass with respect to calorimeter surface.

T_c, T_g = the respective temperatures of the calorimeter surface and the indoor surface of the glass, degrees Rankine (Fahrenheit degrees + 460).

Because the indoor surface of the glass was completely inclosed, F_s is unity. The emissivity of the calorimeter surface has been taken as 0.97, about one percent lower than Hottel's[3] value for a flat black coating of composition similar to that used in painting the calorimeter surface. The emissivity of glass is 0.937[4]. With an area ratio of calorimeter-to-glass surface of 3.5, F_e was found from the following equation to be 0.928.

$$F_e = \frac{1}{\frac{1}{\varepsilon_g} + \frac{A_g}{A_c}\left(\frac{1}{\varepsilon_c} - 1\right)} \quad \ldots\ldots (5)$$

where

ε_c = emissivity of calorimeter surface.

ε_g = emissivity of glass surface.

A_c, A_g = areas of calorimeter and glass surfaces.

The data for computing heat transferred by convection were obtained from tests in which a blank panel with heat meters was substituted for the sheet of glass. Radiation exchange was computed and the convection heat transfer found by deducting this quantity from the total metered heat flow. These tests were made for the dual purpose of obtaining convection data and the unaccounted-for losses from the calorimeter and were carried out as follows. In one case a sheet of rigid insulation board was provided with surface thermocouples and with four sets of differential thermocouples to make a heat flow meter of the blank panel. Constants for these heat meter sections were determined by calibration in a hot plate tester. A second panel was constructed of two sheets of plywood between which four commercial heat meters were sandwiched. In one instance this was placed over the glass to allow the glass to exchange heat with the calorimeter surface and thereby duplicate the radiation conditions of actual tests. The results of these tests are shown in Fig. 2.

In order to extrapolate the convection data with more certainty, results of Griffith and Davis[5] for a 2 in. wide *enclosed* vertical air space have also been plotted on Fig. 2. This air space was about 4 ft square and therefore approximated the conditions prevailing inside the calorimeter. It has been demonstrated that convection conductances are substantially invariable for air spaces of width in excess of $\frac{3}{4}$ to 1 in. It should be noted that the calorimeter data as well as the data of Griffith and Davis are based upon the temperature difference between the two enclosing surfaces.

The heat flow values as determined by computation from experimentally observed temperatures were checked by heat balances in which the following items entered:

1. Heat supplied the calorimeter by the glycol-water mixture,
2. Metered heat leakage from the calorimeter (three sources),

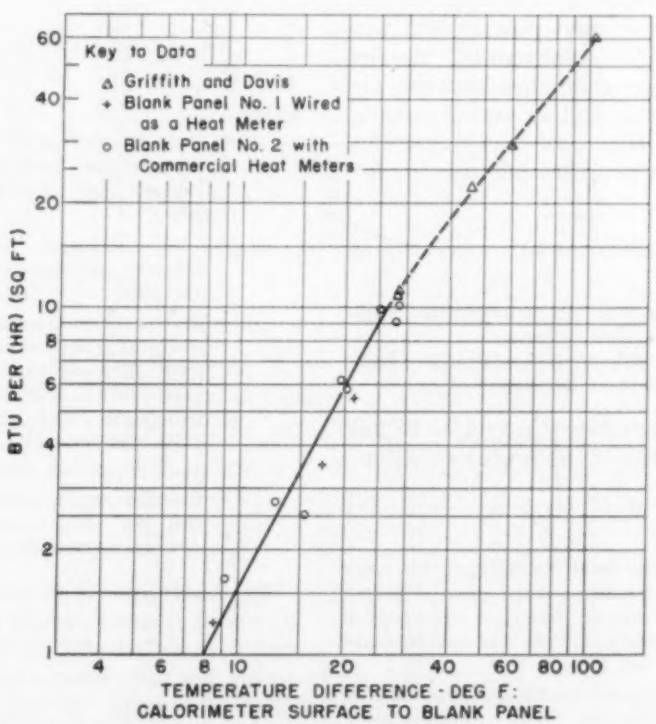


Fig. 2—Convection heat transfer at calorimeter side of a blank panel; panel in vertical position

3. Unaccounted-for heat leakage (determined by calibration),
4. Heat storage effects, and
5. Transmitted solar radiation (day tests only).

Values listed in Tables 1 and 2 checked values determined by heat balance within 5 percent. A number of points were discarded because of unsatisfactory checks. The daytime tests were made on a single glass sheet with orientations that avoided the direct rays of the sun. This glass transmitted 90 percent of normally incident sunlight, 82 percent of diffuse solar energy and absorbed but 2 percent of diffuse solar energy. The amount of diffuse solar energy absorbed by this glass, therefore, was so small that its effect on glass temperature, and hence on the computed heat flow, is considered negligible. Transmittance factors for item 5 were separately determined by calorimeter tests and other means. A sample set of data and calculations is included in an Appendix to be published with this paper in the ASHVE TRANSACTIONS.

Discussion of Results

The Significance of Surface Conductances

Windows differ from most structural elements of buildings in that the principal component, glass, is used in a thin sheet which in itself offers but little resistance to heat flow. The chief factors which govern the heat flow are the indoor and outdoor surface conductances and the conductance of the air space or spaces of multiple glazed windows. Also supporting members, such as sash, mullions and muntins, influence the heat flow through the glass by edge effects and disturbance of air currents, and, by virtue of their area and thermal resistance, may have an important effect on the total heat flow through the window *opening*.

The effect of the surface conductances is illustrated by Equation 3 and data taken from Table 1. For the data listed in line 8, computations show that $\frac{1}{h_i}$ equals 0.783 and that $\frac{1}{h_o}$ equals about 0.252. The first value is based upon surface-to-surface temperature difference, the latter on surface-to-air temperature difference. The value of $\frac{L}{k}$ is approximately 0.023. In this instance the indoor resistance accounts for about 74 percent of the total thermal resistance, the outdoor surface resistance for about 24 percent, while the thermal resistance of the glass accounts for only 2 percent.

Air Space Conductance

The heat flow through the double glass installation has been checked by computing the heat flow by radiation and conduction across the ¼ in. air space. These were based on temperature measurements of the two surfaces bounding the air space. For radiation the shape factor is unity. The emissivity factor is 0.882. The conductivity of air at a mean temperature of 42 F was taken as 0.0142 Btu per (hr) (sq ft) (F deg per ft). The computed heat flow checked the total heat flow from calorimeter to glass within 5 percent. With published[6] values for combined radiation and convection across air spaces, the values checked within 3 percent.

Heat Transfer at the Outdoor Surface

The results showed that the overall coefficients for a sheltered window are slightly lower than for a window exposed to the direct wind. The differences cannot, however, be considered significant because they are within the limits of experimental error. Computation from the data presented in Tables 1 and 2 will show that the average surface conductances for the indoor surface were about 1.30 Btu per (hr) (sq ft) (F deg) for the single glass tests and 1.20 for the double glass tests. These low values mask to a considerable extent the changes in outdoor conditions. For example, a 15 percent increase in the outdoor surface conductance decreases the total thermal resistance only 4 percent. These are approximately the same changes that occur in the outdoor surface conductances and overall coefficients for the two average values of tests on single glass made on January 20-21, 1948.

It is of interest to examine heat transfer at the outdoor surface. Table 3 is an attempt to show the magnitude of the three items which comprise the total heat loss to the outdoor surroundings. The convection conductance was based upon the results of a recent investigation[7] of heat transfer from a smooth surface. The surface length was conservatively taken as half the width of the glass sheet, but no allowance was made for turbulence. In all cases the test house roof temperature was considered to be the temperature of the surroundings at

Table 3—Showing the Components of the Heat Transferred from Outdoor Glass to Outdoor Surroundings

Date	11-25-47	1-20-48	1-23-48	1-26-48
Temperatures, F deg				
1. Calorimeter Surface	71.2	73.9	72.9	76.9
2. Glass: Outdoor Surface	33.2	45.3[a]	31.2[a]	37.8[a]
3. Outdoor Air	31.0	36.3	12.0	24.0
4. Glass to Air	2.2	9.0	19.2	13.8
5. Outdoor Surroundings (Ground & Roof)	30[b]	35[b]	26[b]	33[b]
6. Glass to Surroundings	3.2	10.3	5.2	4.3
Atmospheric Conditions				
7. Wind Velocity, mph	8.1	5.7	4.2	6.8
8. Wind Angle of Incidence	0-90	0-45	0-45	90
9. Sky Conditions[c]	T.O.	T.O.	0.5C	T.H.
Convection Coefficient				
10. Computed (Outdoor), Btu per (hr) (sq ft) (F deg)	3.3	2.5	2.1	3.0
Heat Flow, Btu per (hr) (sq ft)				
11. Total Loss Through Glass	23.6	35.5	53.0	49.4
12. Loss by Convection to Outdoor Air	7.3	22.5	40.3	41.4
13. Loss by Radiation to Ground Surroundings	1.1	3.7	1.7	1.6
14. Items 12 + 13	8.4	26.2	42.0	43.0
15. Unaccounted-for Losses from Glass to Balance	15.2	9.3	11.0	6.4

[a] Estimated from heat flow.
[b] Estimated from observed roof temperature.
[c] Code: T.O., Thin Overcast; 0.5C, 0.5 Cloudiness; T.H., Thick Haze.

ground level. The angle factors for radiant exchange between glass and ground and glass and roof are 0.32 and 0.18 respectively. It will be noted that there is a sizeable unaccounted-for loss.

Nocturnal Radiation

Natural wind is gusty and turbulent on a large scale and little or nothing is known of the quantitative effects of these characteristics on heat transfer. But the computed coefficients for convection have been based on low-turbulence wind tunnel tests of a smooth flat surface. Therefore, part of the unaccounted-for heat loss from the outdoor glass surfaces may be attributed to increased convection due to turbulence.

Part of the unaccounted-for loss must, however, be attributed to the net radiation exchange with the atmosphere, a phenomenon known as nocturnal radiation. This radiation exchange results in a cooling effect because the incoming long wave low temperature radiation from the sky, in the absence of solar effects, is insufficient to balance the outgoing radiation of a surface on the earth. In the daytime this cooling effect usually escapes unnoticed because short wave solar radiation effects more than counter balance the radiative deficiencies of the atmosphere.

For example, during the night tests, the roof surface and the plywood *wall* temperatures were usually a degree or two below air temperature. These temperatures invariably dropped a bit when large clear patches of sky appeared in the overcast, indicating that clearness of the sky is an important factor. More striking evidence of the significance of nocturnal radiation is demonstrated by Table 4. This table gives data that were obtained on a clear day (February 23, 1948) during the course of solar transmittance tests on a single sheet of high transmittance glass. The depression of the glass temperature below those of the outdoor air and the calorimeter surface is due to radiation loss to the sky. This loss is balanced by:

1. Convection from the outdoor air,
2. Radiation and convection from the calorimeter,
3. Solar energy absorbed (about 2 percent) by glass, and
4. Radiation from outdoor surroundings.

This table also shows the estimated net low temperature radiation exchange with the atmosphere and is believed to be conservatively estimated. Computations are shown in an Appendix to be published with this paper in the ASHVE TRANSACTIONS. The late afternoon data show also the effects of radiation from outdoor surroundings which, due to solar effects, are at temperatures above that of the outdoor air. For example, in the 3:15 to 3:45 p.m. period there was negligible heat exchange between calorimeter and glass, yet the glass gained heat from the outdoor air, from the test house roof, from other surroundings (the temperatures of which have been estimated) and a small amount from absorbed solar energy. The calorimeter and glass temperatures shown in Table 4 are, of course, not representative of usual room temperatures, because the tests were run to obtain solar transmittance data with minimum heat leakage corrections.

Data on the magnitude of the net radiant energy exchange between ground and atmosphere are found mainly in meteorological papers. Elsasser[8] has reviewed many of these papers and gives an empirical formula proposed by Brunt for the magnitude of the incoming radiation from a clear sky to a horizontal surface. The radiation is expressed as the ratio of the incoming radiation, R_a, to black body radiation, R_s, corresponding to the air temperature near the ground.

Brunt's equation, with a correction for water vapor, is

$$\frac{R_a}{R_s} = a + b\sqrt{e} \quad \ldots\ldots\ldots\ldots (6)$$

where

a, b = constants determined from observed data.

e = water vapor pressure of the air near the ground, inches of mercury.

The constants as determined by Brunt from data of a number of observers are approximately $a = 0.44$ and $b = 0.47$. Computations with these constants indicate that the net radiation loss from a horizontal surface to the atmosphere for the period 1:30 to 2:00 p.m., Table 4, should be approximately 35 Btu per (hr) (sq ft) for a clear day.

The Influence of Radiation on the Overall Coefficient

In many common cases the usual concept of the U value will not lead to serious error in computing heat losses, provided, of course, that the surface conductances and radiant

Table 4—Radiation Exchange Between Glass and Atmosphere

Time EST	Temperatures, degree F					Wind Velocity mph	Inclination of Glass	Incident Solar Radiation Btu/(hr) (sq ft)	Net Radiation Exchange with Atmosphere Btu per (hr) (sq ft)
	Glass Indoor Surface	Calorimeter Surface	Outdoor Air	Test House Roof					
				Sun	Shade				
10:45-11:30 a.m.	35.7	41.7	38.9	69.4	34.1	5.3	0	10	12
12:45- 1:00 p.m.	36.6	42.3	44.0	86.6	—	6.8	35	15	17
1:30- 2:00 p.m.	39.4	44.6	46.0	84.8	—	6.8	84	160	20
2:30- 3:30 p.m.	45.3	45.1	47.7	81.9	—	6.8	0	155	16
3:15- 3:45 p.m.	45.3	45.1	47.7	76.1	—	7.8	0	140	14

heat exchanges can be correctly calculated. Frequently, however, it happens that solid surfaces or radiating gases emit radiation at temperatures that inconveniently differ from that of the ambient air. The observations just cited in Table 4 are one example of this. In fact the data indicate that the calorimeter surface and the outdoor air temperatures could readily be equal and yet the calorimeter surface could at the same time lose heat to the glass, cooled by nocturnal radiation. Under such a circumstance, U becomes infinite.

In panel heated rooms solid surfaces *seen* by a window commonly differ from the air temperature. Fig. 3 shows how the U value, based upon air-to-air temperature difference, may vary as the temperature of a ceiling panel varies. Two curves are shown. Curve A is based upon convection heat transfer assumed to vary with the temperature difference between window and indoor air but otherwise in accordance with Fig. 2. Curve B is based upon the familiar equation[9]:

$$q_c = 0.27\ (\Delta t)^{1.25} \quad \ldots\ldots\ldots\ldots\ldots (7)$$

where

q_c = heat transfer by convection from air to vertical surface, Btu per (hour) (square foot).

Δt = temperature difference, Fahrenheit degrees, between air and surface.

Radiation heat exchange has been computed by Equation 4 on the assumption that the room is a black body. The authors offer the opinion that as far as practical heated spaces are concerned, Curves A and B of Fig. 2 represent respectively low and moderate convection effects. A typical set of computations appears in an Appendix to be published with this paper in the ASHVE TRANSACTIONS. All values and constants selected for these computations are arbitrary and only by chance may represent conditions chosen for design purposes. The heat flow through the glass is, of course, equal to U times (70-10).

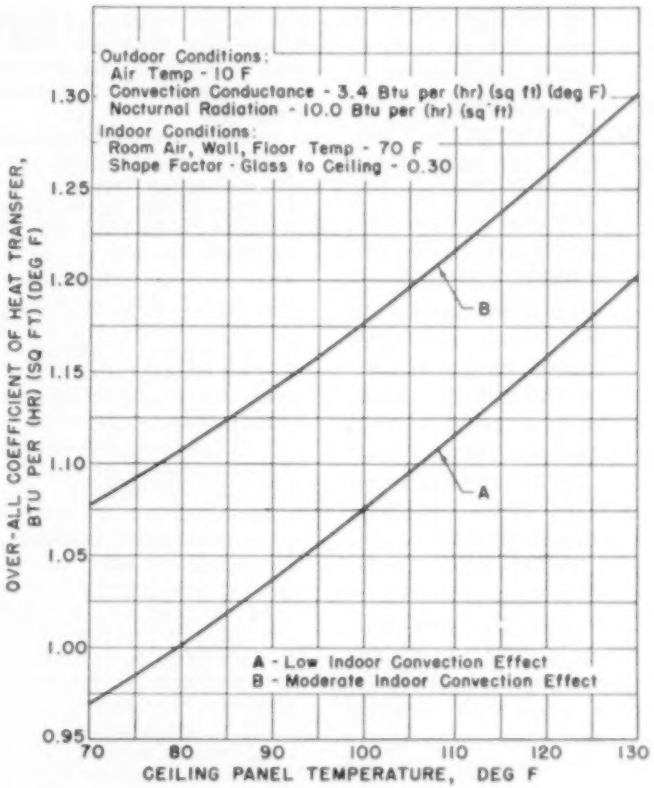


Fig. 3—Calculated effects of indoor radiation and convection conditions on air-to-air overall coefficient for single glass

Comparison With Other Data

Table 5 shows the results of recent[10] guarded hot box tests which included an investigation of such variables as air space width, glass thickness, light size, and air velocity. Data for 30 x 30 in. lights have been selected for comparison because this size approaches the sheet size used in the calorimeter and minimizes muntin effects. The results compare favorably with guarded hot box tests on the basis of overall coefficients. By interpolation, U for a single sheet and 5.7 mph is 0.988. For two sheets of ¼ in. plate at ¼ in. air space and 8.1 mph U is 0.580. Corresponding values from the calorimeter tests of 0.95 and 0.59 are in close agreement. There was, however, considerable difference in both the radiation and convection heat transfer conditions. Nocturnal radiation, wind gustiness, and low indoor convection effects were absent from the hot box tests. On the other hand thermal resistance and turbulence due to muntins were

Table 5—Guarded Hot-Box Determinations of Overall Coefficients of Heat Transmission: Wood Sash with 30 x 30 In. Lights

	Single Glazed Single Strength Glass		Double Glazed—¼ In. Plate Glass			
			¼ In. Air Space		½ In. Air Space	
Warm Side Air, F deg	69.7	68.0	70.8	69.7	69.0	70.8
Cold Side Air, F deg	8.2	11.1	9.8	10.3	10.3	10.3
Warm Side Surface, F deg	34.5	26.0	49.0	44.1	51.2	49.9
Cold Side Surface, F deg	29.9	21.1	26.0	17.2	22.5	14.7
Air Velocity, mph	2.5	14.4	2.5	14.8	2.8	14.3
Heat Flow, Btu per (hr) (sq ft)	54.87	67.00	31.97	38.34	27.82	35.00
U, Btu per (hr) (sq ft) (F deg)	0.892	1.179	0.524	0.645	0.474	0.578

absent in the calorimeter tests. It might be pointed out that after these hot box tests were completed a honeycomb straightener was installed at the entrance to the channel through which air was passed on the cold side of the test panels. This reduced the low velocity values about 8 percent and the high velocity values about 2 percent.

The results of these tests may now be compared with commonly used[11] *U* values, namely 1.13 for single glass and 0.45 for double glass. The former value appears to be a reasonable value if the radiation exchange on the outdoor side approximates black body conditions. As pointed out earlier in this paper it may be on the low side. On the other hand if radiation exchange between glass and indoor surroundings is at a minimum, as in sun rooms or greenhouses, the value of 1.13 may well be too high. Unusual convection conditions, such as are caused by unit ventilators under windows, also need to be considered.

The value of 0.45 for double glass is clearly too low for ordinary conditions and a 15 mph wind. The value for a ¼ in. air space should be of the order of 0.60 to 0.65. For ½ in. or wider air spaces, the coefficient is shown by hot box tests to be of the order of 0.55 to 0.60.

The results of both hot box and calorimeter tests are also in good agreement with the findings of a critical review[12] of published and unpublished data on heat transmission through glass. Analysis of the results of a large number of tests on all types of windows showed that, for practical situations which reasonably approximate hot box test conditions, the presently used value for single glass is a reasonable one but that commonly accepted *U* values for double and triple glazed openings were 20 to 30 percent too low.

Summary

1. Tests for heat loss through single and two air-spaced sheets of flat glass show that radiation exchange between the glass on one hand and the ground surroundings and the atmosphere on the other plays a significant part in heat loss from outdoor surfaces. Because of the limited range of conditions under which these tests were made with regard to wind velocity and clearness of the atmosphere, further investigation is suggested.

2. The uncertainty connected with computing the radiation exchange and the convection loss due to turbulent wind conditions at an outdoor surface indicates the need for improved instrumentation. It is apparent that an instrument is needed which is capable of determining the magnitude of the net low temperature radiant energy exchange between a surface at the earth and the atmosphere. This instrument should be adaptable for both nocturnal and daylight conditions.

3. It has been demonstrated that the *U* value concept as used in estimating building heat losses or gains does not satisfactorily take into account many common radiation exchange conditions. The significant effect of indoor conditions on heat transfer to a window suggests the need for field studies of heat loss through such openings under different typical surroundings.

4. Although the conditions which governed heat loss in the calorimeter tests do not necessarily duplicate the conditions to be found in practical situations, the results indicate that for many cases the currently used *U* value of 1.13 for single glass is a good approximation but that the value of 0.45 for double glazed windows is from 25 to 45 percent too low for design wind velocities. This statement does *not take into account the influence of sash members.*

Acknowledgments

The authors acknowledge with thanks the assistance and helpful criticisms of their colleagues of the ASHVE Research Laboratory staff. They also wish to thank the Libbey-Owens-Ford Glass Co. and the Pittsburgh Testing Laboratory for data used in this report, and the members of the Technical Advisory Committee on Heat Flow Through Glass for useful suggestions and advice.

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ASHVE Extends
Season's Greetings
and
Best Wishes
for a
Very Merry Xmas
and a
Happy New Year

The Fuel Outlook in the U. S.†

By T. W. Hunter*, Washington, D. C.

All of us have a real interest in the subject of fuels not alone as it affects our businesses directly but also because it is the vital factor behind the health, economic well-being, and security of our Nation.

Coal provided the energy upon which the industrial power and high standard of living in America was built and, despite the inroads that have been made against it by other sources of energy, coal is the promise to the United States of a strong and healthy Nation for hundreds of years ahead. In our abundant reserve of this natural energy resource, Providence indeed gave us a great heritage. However, as for our other natural sources of energy, coal should be produced and used wisely. As a Nation we should get the maximum benefit from all of our natural energy resources by using, and conserving, them for those purposes for which they are singularly suited, rather than using them for purposes which could be supplied by other fuels.

Although the estimate that American coal resources will last about 2000 years (at present rates of consumption and with present mining methods) is considered too high, the fact remains that coal reserves are very great, and probably account for 95 to 99 percent of our total mineral fuel reserves on an equivalent heating value basis. Although it is likely that additional large reserves of crude oil and gas will be discovered, these figures emphasize the tight position of our oil and gas supplies in the face of an ever increasing demand. In this respect also, petroleum experts have indicated that whatever oil reserves are yet to be discovered they will be found more slowly, with greater difficulty, and at greater expense than reserves have been found in the past. In view of both the economic and strategic purposes to which gas and oil are uniquely suited, the advisability of the continuation of their use in the displacement of large quantities of coal is questionable from the standpoint of both present and future national interests.

It is only in recent years that many people, including some who are responsible for long range industrial and economic vision, have come to realize that there are serious limitations to our energy resources. Full realization of these limitations has been made necessary by our greatly expanded energy requirements to meet production needs for our increasing population and expanding economy. If future generations of Americans are not to be limited in their energy supplies, there should be wiser planning today in the utilization of our energy resources. They should be used for those purposes for which they are best suited.

Sources of Energy

The United States obtains approximately 48.3 percent of its energy from coal, as compared to 33.8 percent from petroleum (including petroleum imports), 13.6 percent from natural gas, and 4.3 percent from water power. The position of coal as the Nation's primary source of energy is becoming even more important. Although coal has given way in past years to petroleum and natural gas, in the long run the irreplaceable and limited reserves of gas and oil will throw a heavy burden of supplying energy back on coal. Also, coal is the primary source of the expanding synthetic liquid fuels industry. In addition to being the primary source of energy for the manufacture and processing of steel, for the generation of electric power, and the manufacture of gas, coal is the source of strategically important chemicals used in the manufacture of explosives, dyes, synthetic rubber, fertilizers, medicines, plastics and many other important chemicals.

Given its normal material supplies, the coal industry has the plant, man-power, and know-how to produce coal in sufficient overall quantity to meet any presently foreseeable requirements, with the possible exception of the higher quality coals. Aside from inadequate supplies of steel products, including mining machinery and maintenance requirements, the principal factors that can limit coal production are labor difficulties and inadequate supplies of railroad cars.

In 249 days of operation in 1947 the bituminous coal and lignite mines produced 619 million tons of coal. It is estimated that the capacity of the bituminous industry on a 280 day basis of operations is 700 million tons, and for the anthracite industry is 62 million tons, or a grand total productive capacity of 762 million tons.

Over 66 percent of bituminous production is in the Appalachian Region, which covers the area from Pennsylvania and Ohio to Northern Tennessee. This area is favorably located to centers of industry both in the east and the Midwest. The anthracite industry is almost wholly confined to the Northeastern section of Pennsylvania.

The increase in coal output during the war years was featured by the rapid expansion of strip mining. Between 1941 and 1947 strip production increased from 7 to 13 million tons for anthracite and from 55 to 135 million tons for bituminous. On the other hand, as between 1941 and 1947 deep mine tonnage in the anthracite industry decreased 17 percent, or approximately 7½ million tons, and increased only 5 percent in bituminous coal. The decreased proportion of deep mined tonnages produced is very significant because it means that a lesser proportion of the high quality coals are available, which results in a relatively tighter market for these quality coals. The increasing demand for the better qualities has resulted in premium prices for some of these coals, with the result that

† From an address presented at Fuels Meeting of New York Chapter, ASHVE, October 18, 1948.

* Chief, Coal Economics Branch, U. S. Bureau of Mines

it has become more difficult for customary consumers, including coke ovens, utilities, and the Great Lakes trade, to obtain these quality coals.

The relatively small proportion of coking coal reserves, plus the increase in lower grades of production generally, both from stripping and from increased mechanization, have brought about a considerable and continuing increase in the number and kind of preparation plants, which are designed to separate, wash, and clean the lower grades of coal in order to produce a higher quality for the market. The coal industry is now making great advances in coal preparation and cleaning, a development which fuel consumers should take particular notice of.

Another factor which has greatly changed the complexion of the coal market is the change in the size pattern. With the advent of stokers, pulverizers, and other changes in burning techniques the coal industry is changing its overall pattern of sizes so as to more fully and efficiently serve fuel consumers.

Exports

Ordinarily the United States exports but a small proportion of its coal production. Generally close to 90 percent of the export tonnage moves to Canada, which is looked upon as part of the domestic market. Most of the remainder normally goes to South America and Europe. Only in exceptional circumstances have sizable tonnages been shipped from America to Europe. In 1920 during adjustments after World War I and in 1926 during the British coal strike, large amounts of coal were shipped to European destinations. Exports were insignificant during other years between the two world wars. Following World War II Europe again was short of coal. These exports began picking up in August 1945 and for that year amounted to 4 million tons. They increased to 18 million tons in 1946 and 41 million tons in 1947. For the period January-August 1948 overseas exports of bituminous coal were only 15 million tons as compared to 28 million tons during the same period last year.

Quality Coals Short

The American outlook for coal is good, particularly for bituminous coal and lignite, although quality coals will continue to be scarce. Anthracite, with higher mining costs, must face more oil and natural gas competition. In the anthracite primary market in 1947 there was the equivalent of 40 million tons of coal burned in the form of heating oils. Natural gas used for residential and commercial heating on an equivalent basis accounted for about 4.5 million tons of coal in 1946. However, there are limitations to further inroads of these competitive fuels because of the limitations of petroleum reserves and on methods of gas distribution. It is evident from these facts that it would require only a small percentage of conversions from oil and natural gas to throw a heavy load on the anthracite industry.

Production and Distribution

The production of Pennsylvania anthracite in 1947 totaled 57 million tons, a decline of 5 percent from the output in 1946. The principal reason advanced for the decline in production was the insufficient stocking of anthracite by home owners for winter consumption. About 80 percent of the anthracite output is normally used for space heating purposes and when the mines do not work full time during the summer months and when consumers do not purchase a large part of the annual requirement during the summer season, it is difficult for the industry, during the winter months, to step up production sufficiently to meet the increased seasonal demand. It was for this reason, principally, that many domestic consumers of anthracite could not obtain adequate supplies of certain desired sizes during the winter of 1947-48. Although anthracite overseas exports were about 4 million tons in 1947, it is anticipated that they will decline to around 1,800,000 tons in the 1948-49 coal year.

Although bituminous coal production this year probably will be in the neighborhood of from 25 to 30 million tons below the 619 million tons produced in 1947, and it is expected that production in 1949 will be approximately another 30 million tons lower, this is not of as great concern to coal consumers, or to the coal mining industry itself, as it might appear at first glance. With demonstrated productive capacity far above effective demand, it is natural to assume that many mines have drastically curtailed operations or have gone out of business completely. In this respect, it has been estimated by leading economists in the bituminous coal mining industry that during 1947 around 100 million tons of bituminous were produced by "temporary" operations, including small stripping concerns that were diverted into coal mining from road building and construction because of the attractive market, and that an additional 50 million tons were mined by small truck mines that were in the market while demand ran high. Taking into consideration around 100 million tons of captive production, disappearance of the temporary and trucking operations actually means that few established commercial mines have left the market, that better qualities are available, and that there will be adequate production of better grade coals to meet the more normal peacetime demands of our growing economy. It also has been estimated that to meet the Nation's rising energy requirements coal production may reach 760 million tons by 1965, excluding the trend to coal from other sources of energy.

Present Outlook

Turning now toward the short-term outlook, one of the principal points of interest now is the outlook for coal supplies this winter. As indicated in the copies of the Weekly Coal Report of the U. S. Bureau of Mines, bituminous coal stocks reported as of September 1 for all classes of consumers covered by our survey averaged 64 million tons and 49 days supply, as compared to 47 million tons and 37 days supply on September 1 last year, increases of 17 million tons and 12 days supply. The difference between this year and last is accounted for

by several factors, principal of which are the drop in exports of U. S. coal to Europe, the severe weather conditions during the first quarter of this year with accompanying transportation difficulties that resulted in lower coal production, and the strong effect on consumer psychology of the suspension of coal production during the miners' pension dispute and by the controversy between the captive coal mines and the miners' union. These facts were largely responsible for the heavy flow of coal into consumers stockpiles—even of some qualities of coal that would not have been bought except for the uncertainties that existed.

Stockpile Size Important

Despite these large stockpiles, bituminous coal production continues just under 12 million tons per week, which means that current day-to-day consumption is still high throughout the economy. Also, it must be remembered that these stock figures are averages for each of the respective industries. From past experience in breaking down the stock figures on frequency intervals of 5 days, it is notable that a large number of consumers have stocks of considerably less than 30 days supply. For such consumers the sudden changes that frequently develop in the coal mining industry are of great concern, and it is they who are most interested in an orderly pattern of bituminous coal production and distribution. As most of you know from experience, serious interruptions to the production and distribution of coal, whether they be caused by labor controversies, transportation difficulties, severe weather changes, or other reasons, threaten real damage to the health and economic welfare of many millions of people. Accordingly, the size of the Nation's stockpile is very important.

Although the market for anthracite is tighter than for bituminous, it is believed that there will be adequate supplies available during the coming winter months, provided that those consumers who have not yet done so will immediately place their orders for their winter supplies.

Summarizing, whereas last fall and winter there were serious complaints from many sections of the country about inadequate coal supplies, for industrial purposes as well as for large scale heating and household use, there is little likelihood of such shortages this winter except for some of the better qualities and some of the popular sizes.

COAL RESERVES DEBATED AT FUELS CONFERENCE

A completely new and detailed estimate of the coal reserves of the United States is a 10-year project of the U. S. Geological Survey, Paul Averitt of that agency disclosed at the opening of the 11th National Fuels Conference of the *American Society of Mechanical Engineers* and the *American Institute of Mining and Metallurgical Engineers* at the Greenbrier, White Sulphur Springs, W. Va., November 3. Pointing out the need for such a survey of the nation's coal resources, Mr. Averitt said it will require about 10 years for completion of the project, though much specific information will be available meanwhile. He also pointed out that currently used figures on U. S. coal reserves were last revised in 1928, and only minor changes made since then.

He stated that field work is in progress or reports are in preparation at present on 13 detailed mapping projects, including the Pennsylvania anthracite field, fields in Maryland, Kentucky, North Carolina, Alabama, Montana, Wyoming, four fields in Colorado, and in New Mexico and Washington. A series of procedures for calculation and tabulation used by the Geological Survey was submitted by Mr. Averitt to the fuels engineers for comment.

A program for the production of one million barrels daily of synthetic oils from coal was outlined by J. D. Doherty, assistant chief, Office of Synthetic Liquid Fuels, U. S. Bureau of Mines. Describing work in research and development already under way by the Bureau of Mines and others in the production of synthetic liquid fuels, Mr. Doherty called for an investment of 8.7 billion dollars, including plants, mines and product pipe lines.

The million barrels per day of oil-from-coal would consist of the following products: liquified propane and butane (L.P.G.) 86,000 barrels; high grade motor gasoline, 648,000 barrels; diesel and furnace oil, 266,000 barrels. Heavy fuel oil, which could be obtained more cheaply from shale, was not included. The cost of production, per gallon of total products, would be 12.4 cents, or 12.6 cents, depending on the process used. Mr. Doherty declared that the day when synthetic oil from coal will begin to supplement our petroleum supplies does not appear to be far off.

Estimated liquid fuels resources of the United States are as follows: coal and lignite, 87 percent or 2,600-billion barrels; oil shale, 9 percent or 270-billion barrels; petroleum and natural gas liquids, 2.9 percent or 86-billion barrels; natural gas, 1.6 percent or 48-billion barrels.

The Bureau of Mines has under way research and development work in both the principal processes. Extensive work is being carried on by most of the leading oil companies and industrial firms.

Continental Fuel Utilization

Speaking at a luncheon meeting on Continental Fuel Utilization, Carl E. Miller, technical advisor of Battelle Memorial Institute, Columbus, Ohio, stated that increased utilization of low-grade fuels in Europe presents a hope for the *long pull* toward economic recovery on the Continent.

The coal situation has been changing for several months in certain European areas from one of shortage to one of relative surplus, he said. These surpluses in general are the lower grade fuels, which require special technical knowledge for their maximum utilization. An American resolution was presented to the United Nations ECE organization proposing an intensive survey of the use of low-grade fuels, and was provisionally approved by the coal sub-committee.

Summary of Local Chapter Meetings*

Atlanta—October 1, 1948. The Atlanta Chapter members met at the Harris, Inc., dining room, Atlanta, on October 1, and Pres. L. L. Barnes presided. S. W. Boyd, chairman of the code committee, announced that the director of the Smoke Abatement Bureau of the City of Atlanta had requested recommendations on the draft of a city code to cover air conditioning and refrigeration installations. Mr. Boyd presented the written report of his committee, and the recommendations and conclusions drawn therein were made the subject of a motion to adopt, which was seconded and unanimously carried. It was agreed that President Barnes advise the director of the Smoke Abatement Bureau of the Chapter's action.

E. K. Jamison, treasurer, reported on the Chapter's finances and also called attention to the delinquent members' list.

President Barnes then turned the meeting over to C. V. Fenn, who introduced the speaker of the evening, William H. Reed, III, district manager, Industrial Heating Department, Carrier Corp., Charlotte, N. C. Mr. Reed spoke on unit heater developments and applications which proved very interesting and instructive. An interesting discussion followed, and the meeting adjourned at 9:15 p.m. Attendance 51. Attendance ratio 0.44.

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Central Ohio—September 20, 1948. Pres. W. M. Myler, Jr., presided at the first meeting of the year at the Chittenden Hotel, Columbus, on September 20.

R. B. Engdahl stressed the importance of every member assisting in obtaining new members at the beginning of the season. R. M. Keatts, of the program committee, announced that Carl F. Boester, director of Housing Research at Purdue University, Lafayette, Ind., was scheduled as the speaker for the October meeting, and that the November meeting would be a joint meeting with the Columbus Technical Council.

John W. Norris, vice president, Lennox Furnace Co., the guest of the evening, addressed the gathering on Solving Problems of Producing Comfort in Residences by the Use of Forced Air Systems. Mr. Norris gave an enlightening talk on the correct installation of control setting procedures in a modern forced air heating system. Continuous blower operation and correct register locations were particularly stressed by Mr. Norris, along with the desirability of short, frequent impulses of heat. He also pointed out that with both radiant heating and forced warm air heating good building construction was important. A spirited question and answer period followed. Attendance 54.

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Connecticut—October 14, 1948. The Connecticut Chapter of the *ASRE* was host to the ASHVE members of the Connecticut Chapter at a joint meeting held at Meriden. Walter L. Fleisher, president, Air and Refrigeration Corp., New York, and past president of the ASHVE, gave a very interesting talk on Air Distribution and Its Difficulties in Large Buildings.

An announcement was made that Dean L. E. Seeley, former Chapter member and now Dean of the College of Technology, University of New Hampshire, Durham, N. H., would be the speaker at the November meeting. Attendance 62. Attendance ratio 0.39.

Delta—October 12, 1948. The regular monthly meeting of the Delta Chapter was held at the New Orleans Athletic Club with Pres. L. V. Busenlener presiding. John S. Burke reported on a meeting of the Technical Papers Committee of the *Louisiana Engineering Society* and announced the joint meeting with the *LES* which is scheduled for January 14-15, 1949. It was decided to omit the regular dinner meeting of the Delta Chapter in January, in favor of the session with the *LES*. Ted Offner introduced the speaker, H. C. Pierce, Servel, Inc., Evansville, Ind., who gave an interesting and informative talk on Gas-Fired Air Conditioning, after which he answered a number of questions asked by the members. Attendance 48. Attendance ratio 0.45.

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Golden Gate—October 7, 1948. Members and guests assembled at the Engineers Club for the October Chapter meeting, with Pres. H. V. Hickman presiding. Several reports were given by the committee chairmen, and J. E. Murray reported on his activities in contacting the *AIEE* relative to State of California construction design work and outlined their objections to any political move on their part with the State. The resolutions for the amendments to the Chapter By-Laws were read, and it was moved by J. S. Rose, seconded by D. E. McLeod, that the amendments be accepted. A unanimous vote was given by the members to accept the changes as outlined.

William Gleeson, McDonnell & Miller, Inc., spoke on the subject of Boiler Safety Controls. Following Mr. Gleeson's interesting talk, which he illustrated with slides. Eric Roberts, chapter member, also with McDonnell & Miller, Inc., discussed Hot Water Boiler Controls, which he illustrated with slides.

* Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

UNIVERSITY OF MICHIGAN LIBRARIES

The meeting adjourned at 9:35 p.m. Attendance 67. Attendance ratio 0.33.

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Illinois—October 11, 1948. The first Illinois Chapter meeting of the 1948-49 season was opened by C. M. Burnam, Jr., president. W. A. Kuechenberg, general chairman of the Committee on Arrangements for the Society's forthcoming Annual Meeting in Chicago, was called upon to discuss the current status of arrangements, and he reported that all committees had been organized, their membership totalling 86. He also reported that the Ladies Committee was already functioning and that tentative plans indicated a successful ladies' program.

Harry G. Gragg, a member of the meetings committee, introduced the speaker of the evening, James N. Livermore, mechanical engineer, The Detroit Edison Co., Detroit, Mich., who spoke on Latest Trends, Commercial Air Conditioning. He discussed, in detail, the Detroit Edison service building which was built in 1938. He called attention to the fact that the architecture was unique in that all natural lighting was done with glass block and no windows were provided for ventilation. He explained that although in 1938 this was a unique and extremely modern method of building construction, already in 10 years there are many signs of obsolence.

Mr. Livermore, in discussing the design of the air conditioning system for this building, dwelt on the importance of determining the cooling load. He further explained that even with current data it is still difficult to accurately determine any cooling load, and that in his opinion most cooling systems are unnecessarily oversized.

From the data given, it was interesting to note that the system was designed to require 450 tons of refrigeration, although, actually the maximum load encountered has been about 360 tons under the worst conditions. One reason for this, perhaps was the fact that information on glass block in 1938 was not as accurate as it is today.

Mr. Livermore, in concluding, pointed out that new low ceilings of 9 ft 6 in., compared with 11 ft ceilings in older buildings, have changed air conditioning and control problems. In his opinion, perforated ceilings are at present, in many cases, about the best answer for distribution. He also offered the opinion that the present day trend toward electrostatic filters for air is gaining momentum. From the discussion that followed Mr. Livermore's talk, it was evident that it was thoroughly enjoyed by the members and guests. Attendance 117. Attendance ratio 0.29.

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Manitoba—September 23, 1948. Pres. J. R. Stephenson presided at the get-together which was held at the Aqua Terra Club, Fort Garry, where members, guests, and their wives enjoyed an evening of dancing and later singing around the camp fire. *Hot dogs* and corn-on-the-cob were provided through the effort of Mr. and Mrs. J. A. Bell, and were thoroughly enjoyed by everyone. Music was furnished by Prof. Roy Clark on the accordion. Attendance 23. Attendance ratio 0.29.

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Montreal—September 22, 1948. The golf meet of the Montreal Chapter was held at the Whitlock Golf and Country Club on Wednesday, September 22. The committee in charge consisted of B. J. Horsburgh, Jack Wright, Franklin A. Sheppard, and W. G. Hole. Dinner was served at 6:30 p.m., following the tournament, and Pres. Leo Garneau turned the presentation of awards over to Mr. Horsburgh, who in turn called on various members of the Chapter to make appropriate presentation speeches. The cup was awarded to D. Lorne Lindsay. Attendance 52.

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Nebraska—October 12, 1948. The October meeting was called to order at the Regis Hotel, Omaha, by K. R. Magarrell, president of the Chapter. Carl E. Swanson, Heating Controls Division, Minneapolis-Honeywell Regulator Co., speaker of the evening, gave an enlightening talk on Electronic Combustion Controls, which he demonstrated for both gas and liquid fuels. A question and answer period followed. Attendance 30.

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New York—October 18, 1948. Speakers at the regular monthly dinner meeting were T. W. Hunter,* chief, Coal Economics Branch, and F. S. Lott, assistant chief, Petroleum Economics Branch, U. S. Bureau of Mines. Mr. Hunter outlined the importance of coal and the need for using it wherever possible in order to save other fuels, such as oil and gas, for applications to which they were especially suited. He reviewed the past and current production of coal and stated that total coal mined per year in the United States would probably reach 760 million tons in 1965.

Mr. Lott explained that lack of tankers and pipe lines had been the main cause of the shortage of oil experienced in the New York area during the 1947-48 season. For the coming season it was expected that supply would be adequate for normal demand. He referred to plans which called for a daily delivery by a contemplated pipe line of 340 million cubic feet of South Texas natural gas to the New York area public utilities for replacement of oil and some solid fuel in gas making. Such a project, he stated, should have a beneficial effect in making coke and distillates, as well as gas more plentiful for heating use.

Ten new members were added to the Chapter roll and were introduced by C. S. Koehler, membership chairman.

Pres. A. A. Bearman announced the new Committee Chairmen as follows: C. S. Koehler—*Membership;* A. A. Giannini—*Program;* B. B. Howes—*Reception;* and Bernard Leventhal—*Christmas Party.*

* Mr. Hunter's talk published in detail on p. 119.

JOURNAL SECTION

North Texas—September 13, 1948. The White Plaza Hotel, Dallas, was the meeting place for the North Texas Chapter's September meeting, at which Pres. B. S. Foss presided. President Foss reminded the members and guests that G. L. Tuve, Cleveland, Ohio, president of the Society, would be the featured speaker at the November meeting.

The meeting was then turned over to L. L. Landauer, who introduced Thomas H. Urdahl, consulting engineer, Washington, D. C. Mr. Urdahl addressed the gathering on Design Time Savers, pointing out that many ingenious devices have been made by various people and used to a very definite advantage during the past war to speed up production of battleships. After Mr. Urdahl's interesting talk, several slides were shown, followed by a short movie describing the dehumidification of vessels for lengthy storage. Attendance 96. Attendance ratio 0.42.

North Texas—August 16, 1948. The members and guests met at the Melrose Hotel and B. S. Foss, Jr., president, presided at the August meeting. Considerable discussion took place on the Chapter's administrative work and especially the heavy duties of the secretary. A. M. Harris was appointed chairman of the publicity committee for the Fort Worth section, and a good deal of discussion on local publicity followed. President Foss announced that there were two research reports available at the headquarters office in New York, and pointed out that these reports gave the progress being made on investigations under way at the Society's Research Laboratory in Cleveland.

C. Rollins Gardner reported on the progress made thus far on the plans for the 1950 Annual Meeting scheduled for Dallas, and called for the cooperation of each and every member. Attendance 45. Attendance ratio 0.41.

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Northern Ohio—September 17, 1948. The meeting was called to order by Pres. W. R. Moore in the dining room of the Chagrin Valley Country Club, Cleveland. L. C. Burkes, chairman of the entertainment committee, arranged for an afternoon of golf and a television broadcast of the Indians ball game. Mr. Burkes was congratulated for his excellent arrangements. The entertainment committee then took over the meeting and distributed the golf awards.

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Oklahoma—October 5, 1948. Beverly's Drive-In, Oklahoma City, was the meeting place for the members and guests of the Oklahoma Chapter for their October meeting. J. H. Spaan, Jr., president of the Chapter, introduced the speaker of the evening, Carl F. Boester, Director of Housing Research, Purdue Research Foundation, Purdue University, Lafayette, Ind., who spoke on the subject, Reverse Cycle Refrigeration Combined with Radiant Heating as Applied to Small Homes. Mr. Boester's talk was very well received and it was the opinion of all that a great deal was learned about the subject. The Chapter members expressed the hope that Mr. Boester would be in a position to visit the Oklahoma Chapter at some future date. Attendance 66.

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Ontario—October 4, 1948. Pres. E. G. Spall opened the first meeting of the season at the Royal York Hotel, Toronto, and introduced the chairmen of the various Chapter committees. Dr. A. D. Misener, assistant professor of physics, University of Toronto, gave an illustrated talk on the Future of the Heat Pump, which was followed by a very interesting discussion. J. H. Ross extended sincere thanks to the speaker for a very instructive evening. Attendance 125. Attendance ratio 0.34.

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Oregon—October 7, 1948. The regular dinner meeting of the Oregon Chapter was held at the Heathman Hotel, Portland, with Pres. E. R. Lokey presiding. W. A. Simpson introduced the speaker of the evening, R. H. Walpole, Jr., Pacific Coast Supervisory Engineer, Dust Control Division, American Air Filter Co., who addressed the meeting on the subject, Industrial Ventilation, Dust Control and Smoke Abatement. He stated that silicosis court action in the 30's started the main drive in dust control and gave figures on interior waste being dumped to the city skies, and gave extensive figures on percentages, pollution and contamination of air; he discussed the use of Ringelmann smoke charts and gave specific examples of many serious air contamination problems.

A lively discussion followed Mr. Walpole's talk, in which K. N. Flocke, cited requirements of the State Board of Health in respect to interior and exterior control. He also said that aluminum plants are not health hazards so that health authorities cannot act. Mr. Walpole, at the conclusion of the discussion, commented on methods of air filtering which he described as: (1) electronic—most expensive; (2) filters or bag-pipes—less expensive; and (3) wet collectors—least expensive and smaller in size.

President Lokey called for election of a nominating committee and B. W. Farnes, chairman, T. E. Taylor, C. W. Brissenden, J. Donald Kroeker and R. C. Chewning were duly elected. Attendance 57. Attendance ratio 0.38.

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Pacific Northwest—October 7, 1948. L. L. Bysom, president, called the first meeting of the 1948-49 season to order at the Engineers Club. He announced the appointment of R. H. Liniger as chairman of the membership committee, J. D. Sparks, program chairman, and E. L. Weber as Chapter representative on the Engineering Council. Following an announcement about the increase in Chapter dues, the meeting was turned over to the program chairman, who announced the programs scheduled for the next three months. He called attention

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to the December and January 1949 meetings which will be devoted to debates, one on Electric *vs.* Pneumatic, and the other on Aluminum *vs.* Galvanized Sheet. Mr. Sparks then introduced the guest of the evening, D. D. Wile, chief engineer, Refrigeration Engineering, Inc., Los Angeles, Calif., who presented a talk entitled Simplification in Selection of Air Conditioning Coils. Mr. Wile's talk proved instructive and enjoyable. Many questions were answered by the speaker at the conclusion of his talk. Attendance 46.

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Philadelphia—October 14, 1948. J.O. Kirkbride was the presiding officer at the October meeting of the Philadelphia Chapter, which met at the Engineers' Club. The minutes of the May meeting and the treasurer's report were read and approved. The guest of honor was Prof. William F. Wells, School of Medicine, University of Pennsylvania, who addressed the meeting on Sanitary Ventilation. Attendance 60.

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Pittsburgh—October 15, 1948. The annual joint meeting of the *ASRE* and ASHVE Pittsburgh Chapters was held at the Sheraton Hotel, with the *ASRE* as the host for the evening. No business was transacted. Pres. H. E. Park of the ASHVE announced that Lester T. Avery, Cleveland, Ohio, second vice president of the ASHVE, would be the speaker at the next meeting.

The golf trophy was presented to the *ASRE* members who had won it at the tournament held at the Chartiers Country Club in May. Larry McCann presented the cup in honor of L. S. Walker, and the presentation was followed by movies taken the day of the tournament showing the golfers in action.

Mr. Cordrey, chairman of the *ASRE*, then introduced the guest of honor, William B. Henderson, executive vice president, *Air Conditioning and Refrigerating Machinery Association*, Washington, D. C. Mr. Henderson spoke on the subject of Refrigeration and Air Conditioning. He pointed out what air conditioning has meant to the public and what can be expected in the future. He explained that there are so many things that depend on air conditioning that one should think of the future. His talk was interesting and thoroughly enjoyed, as was evident from the discussion which followed. Attendance 53.

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South Texas—October 15, 1948. A report on Chapter funds, by H. W. Broadwell, treasurer, was the first order of business at the South Texas Chapter's October meeting, which was held at the Rice Hotel, Houston, and was presided over by C. C. Quin. A. F. Barnes, Chapter representative on the Engineers' Council of Houston, reported.

Announcement was made of the plans for a joint meeting of the South Texas members and the Texas A. & M. Student Branch to be held in November with G. L. Tuve, president of the Society, as the guest of honor. S. E. Ammons, president of the Student Branch reported on plans for the joint meeting. L. L. Ladewig reported on the progress made toward arranging for a special train for the convenience of the Texas members who plan to attend the 55th Annual Meeting of the Society in Chicago, January 1949. Following a report by R. F. Taylor on the Society's Council meeting in Memphis, Tenn., John Berry, local representative of Chase Brass & Copper Co. and a member of the South Texas Chapter, introduced the speaker, S. A. Selby, Jr., project engineer, Development Department, Chase Brass & Copper Co., Atlanta, Ga., who spoke on Radiant Heating. Attendance 90. Attendance ratio 0.33.

South Texas—September 10, 1948. Ship Ahoy Restaurant, Houston, was the meeting place for the September meeting of the South Texas Chapter at which Pres. C. C. Quin presided. Announcement was made that the North Texas Chapter reported that 60 reservations had already been made for the special train from Texas to Chicago for the forthcoming Annual Meeting of the Society, and a total of 125 reservations was necessary to obtain a special train.

The speaker of the evening, Thomas H. Urdahl, consulting engineer, Washington, D. C., was introduced. Mr. Urdahl talked on the topic, Design Time Savers, which dealt primarily with slide rules used to speed up production in heating and ventilating work on Naval vessels. Mr. Urdahl also showed a film dealing with the storing of Naval vessels so that they may be put back in operation on short notice. The talk was most instructive and enlightening and enjoyed by the members and guests in attendance. Attendance 90. Attendance ratio 0.31.

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Southern California—September 22, 1948. A joint meeting with the *American Society of Refrigerating Engineers* and the *Refrigeration Contractors Association* was held at the Rodger Young Auditorium and all Chapter business was dispensed with. Walter E. Elieson, Western Representative of the U. S. Department of Commerce, was the guest speaker. He gave an interesting talk on business prospects for the Southern California district for the coming year. Attendance 103.

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Virginia—October 14, 1948. Jesse E. White, acting president, called the October meeting to order at the Waltonian Club, Norfolk, after an enjoyable steak dinner. Mr. White welcomed the guest of the evening, Alfred E. Stacey, Jr., Syracuse, N. Y., first vice president of the Society, who addressed the meeting on the subject, Engineering and Economic Mobilization. Mr. Stacey reviewed the founding and incorporation in 1895 of the Society, its growth up to the present with close to 7000 members, and the establishment of the Research Laboratory in 1920. He showed some slides depicting the work done at the Laboratory. He

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also told of the first edition of THE GUIDE in 1922, with a new edition each year.

Mr. Stacey stated that economic mobilization may be defined as the application of human production to the support of a war effort Following this he showed the organization of the National Security Council and told of the task it has to perform. Within the Council, he explained, there is a Research and Development Board which advises the Secretary of Defense on items of research and development. It is the duty of this Board, he went on to explain, to petition the requirements of civilian and military needs. In all this activity, Mr. Stacey pointed out, certainly the ASHVE has a definite part to play. Attendance 31.

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Western Michigan — October 11, 1948. The October meeting of the Western Michigan Chapter was held in the Y.W.C.A., Grand Rapids, with Pres. H. W. Wolters presiding. One minute of silence was observed in memory of C. V. Saunders, secretary of the Chapter, who recently passed away. H. R. Limbacher was appointed by the Board of Governors to fill the vacancy caused by Mr. Saunders' death. Following the treasurer's report and several announcements of Chapter interest, the meeting was turned over to J. L. Alexander, vice president, who introduced the speaker, S. S. Sanford, heating, ventilating and air conditioning engineer of The Detroit Edison Co., Detroit. Mr. Sanford talked on the Heat Pump, briefly discussing its development and comparing its operation with the common electric refrigerator with which all are familiar. He gave some interesting figures, pointing out that if electricity were used for direct heating in the home, electricity at $0.02 per kwhr would be equivalent to $0.55 per gal of fuel oil and $85.00 per ton of coal. He further explained, if electricity at $0.02 per kwhr were used in a heat pump, equivalent fuel consumption would be equal to fuel oil at $0.22 per gal and coal at $34.00 per ton. He also discussed the efficiency of operation and heat transfer in various coils, and concluded his talk by showing slides to illustrate his comments. Attendance 84. Attendance ratio 1.0.

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Western New York—October 18, 1948. The first Fall meeting of the Western New York Chapter was held at the plant of the Buffalo Forge Co. A dinner was served in the cafeteria at 7:00 p.m., following which there was an inspection trip through the plant. A business meeting followed. This was held in the test room and Pres. Edwin Woolcock presided.

Sec'y. Tom Killeen read the minutes of the previous meeting and Chapter Delegate Roswell Farnham reported on the Semi-Annual Meeting at Bretton Woods and announced that the next meeting of the Chapter would be held November 15 with the engineering students at the University of Buffalo.

Arrangements have been made with Dean Mohn of the Engineering College for a round table discussion with the students. The Chapter will provide a panel which will include a consulting engineer, contractor,

Western New York Chapter members inspect Buffalo Forge Co. plant at Buffalo

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manufacturer, salesman, representative for control equipment and one man representing research. Representative questions will be prepared in advance of the meeting in order to stimulate discussion. A cafeteria supper will be served at the University. William Heath will act as chairman. It was also voted by the Chapter to present the Engineering Library of the University of Buffalo with copies of the Society's GUIDE, the TRANSACTIONS and the JOURNAL, *Heating, Piping & Air Conditioning*. Roswell Farnham announced that he had already given the Library the bound TRANSACTIONS from 1921 through 1946.

On behalf of the Chapter, Joe Davis presented Bertram Candee with an engraved desk letter tray in recognition of his services as treasurer of the Chapter for 14 years.

The annual Christmas party will be held at the University Club, December 15, and plans are being made for a National Officers night, January 10. At this meeting it is hoped to have a number of the national officers, including Secy. A. V. Hutchinson.

At the close of the meeting a vote of thanks was given to Buffalo Forge Co. for a very pleasant evening. Attendance 78.

Student Branches

North Carolina State College—October 12, 1948. J. G. Marshall, president of the Student Branch, presided at the October 12 meeting which was held in Page Hall at the College, Raleigh, N. C. Von Autry, Jr., treasurer, gave a financial report which was followed by a discussion of dues. It was moved, seconded, and approved that yearly dues be increased to $5.00 a year ($3.00 for the Society and $2.00 for Student Branch dues) and that there be an additional initiation fee of $1.00 for new members. President Marshall turned the meeting over to Prof. L. L. Vaughan, faculty advisor at North Carolina State College, who introduced Jack T. Still, Warren Webster Co., as guest speaker. Mr. Still gave a very lucid and graphic talk on the Necessary Accessories for a Low Pressure Vapor System, using sketches to illustrate his talk. In proper sequence, he unfolded the entire heating system, and as each piece of apparatus, necessary for the proper functioning of the system was introduced, a wealth of pertinent information was given. Mr. Still's talk, though specific and technical, was well geared to the level of his audience and was well received by the Student Branch. A short question and answer period followed in which Mr. Still expanded even more on those items that were of particular interest to the student body. At the conclusion of the discussion, Philip St. John Moore thanked Mr. Still, on behalf of the Student Branch, for his excellent presentation. Attendance 30. Attendance ratio 1.

North Carolina State College—September 28, 1948. President Marshall called on Mr. Moore, program chairman, to submit the tentative program for the coming school year. He announced the joint meeting planned for October 15 with the North Carolina Chapter of the Society, at which Alfred E. Stacey, first vice president of the Society, is scheduled to talk, and then told of the two meetings planned for November 9 and 20, with H. A. Lockhart, chief engineer, Bell & Gossett Co., to speak at the first meeting on the subject of Hot Water Heating, and the latter meeting being devoted to an inspection trip through the Norfolk Navy Yard, Norfolk, Va. At this meeting, which will cover heating, ventilating and air conditioning of sealed ships, there will also be a lecture on torpedo thermodynamics. Mr. Moore also announced that there were plans for other speakers during the season and these would be announced later. Attendance 23. Attendance ratio 1.0.

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Texas A. & M. College—September 30, 1948. This meeting was called to order in the lecture room of the Mechanical Engineering Building by Pres. S. E. Ammons. C. C. Quin, president of the South Texas Chapter, extended an invitation to all students to attend the Chapter meetings in Houston and offered wholehearted support to the Student Branch. Announcement of the forthcoming visit of President Tuve, to the South Texas Chapter's meeting, was made and the students were invited to join the Chapter for this meeting. H. L. DeVines, speaker of the evening, gave an interesting lecture-demonstration of his *Lil Atom, Jr.*, air conditioning unit, which proved to be one of the most unique programs given to the Student Branch. Attendance 53. Attendance ratio 0.67.

Texas A. & M. College—September 23, 1948. The first meeting of the Fall semester at the College was called to order by Pres. S. E. Ammons. C. W. Crawford, head of the Mechanical Engineering Department at the College, made a few brief comments on the progress and spirit shown by the members of the Student Branch of the Society, and introduced Prof. L. S. O'Bannon, of the Air Conditioning and Refrigeration Department. Professor O'Bannon gave a very interesting talk concerning his experiences in the heating, ventilating and air conditioning field. Of particular interest was the mention of his association with the late Dean F. Paul Anderson at the Society's Laboratory when it was first organized at the U. S. Bureau of Mines, Pittsburgh, Pa. Professor O'Bannon concluded his remarks with the hope that the Student Branch would continue with even greater success in the future. A motion was then made that the office of secretary-treasurer be resolved into two offices with the result that C. P. Howard was elected to remain as secretary and C. V. Brown was elected to serve as the new treasurer. Plans for the annual joint meeting with the Texas Chapters were discussed with the result that President Ammons appointed a committee to investigate the possibility of holding this meeting early in December. Attendance 50. Attendance ratio 0.76.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 100 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by December 26, 1948, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

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PERSONALS

A. C. Buensod, president of Buensod-Stacey, Inc., New York, N. Y., air conditioning and refrigeration engineering contractors of New York and Charlotte, N. C., has announced that Martin E. Snyder has been appointed comptroller. Mr. Snyder formerly was secretary and treasurer of the Carrier Corp. and resigned his position in 1946.

G. E. Scott, Buffalo, N. Y., has announced his resignation as vice president and director of sales of the Rittling Corp. Mr. Scott, who received his B.S. in mechanical engineering from the University of Kentucky, is known throughout the heating, ventilating, air conditioning and refrigeration fields. He is a past president of the *Industrial Unit Heater Manufacturers' Association* and is a member of the ASHVE.

William Worton

WILLIAM WORTON DIES

Word has been received from the Manitoba Chapter of the death, on September 23, 1948, of William Worton of C. A. Dunham Co., Ltd., Winnipeg, Manitoba, Canada.

Mr. Worton, a member of the ASHVE since 1936, was born in Scotland, July 21, 1884, where he received his early education. In 1923 he became associated with Clare Bros. Ltd., Winnipeg, as manager of the Heating Department. From 1931 to 1936 he acted as consultant, and in 1936 he became manager of the Winnipeg Sales Office of C. A. Dunham Co., Ltd. He drew up plans and specifications and supervised the heating and air conditioning installations in residences, hotels, churches, and in such buildings in Winnipeg as the Federal Building, Post Office annex, the Royal Crest and Bessborough Apartments, Union Trust Building, Canadian Bank of Commerce and the Western Canada Airport.

Mr. Worton is survived by his widow and three sons, Keller, Gilbert and Fred, to whom the Society extends deepest sympathy.

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September meeting of the Guide Publication Committee held at Society's Research Laboratory, Cleveland, Ohio. *(l. to r.)* W. N. Witheridge, W. M. Wallace, II, H. R. Limbacher, R. L. Byers, C. M. Humphreys, R. C. Cross, *chairman*, Carl H. Flink, A. B. Algren, B. H. Jennings, R. P. Cook

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Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, Fred Janssen, 1123 W. Third Ave., Denver 9. Secretary, F. C. Allen, 4467 King St., Denver 11.

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St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, B. L. Evans, 571 Stratford Ave., University City. Secretary, C. H. Burnap, 1635 Syndicate Trust Bldg., St. Louis 1.

Shreveport: Organized 1948. Headquarters, Shreveport, La. President, W. E. FitzGerald, 939 Louisiana Ave., Shreveport. Secretary, O. J. Dykes, Jr., 1012 Market St., Shreveport.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, C. C. Quin, 809 Stuart Ave., Houston 6. Secretary, R. J. Salinger, 4510 Dewberry Lane, Houston 4.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. President, R. S. Farr, 2615 Southwest Dr., Los Angeles. Secretary, L. J. Helms, 633 S. Berendo St., Los Angeles 5.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, G. R. Rhine, 1208 Alamo National Bldg., San Antonio. Secretary, I. W. Wilke, 422 Congress Ave., Austin.

•

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, E. J. Watts, 2485 Douglas St., Salt Lake City 5. Secretary, R. H. East, 326 E. First So., Salt Lake City.

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Virginia: Organized, 1946. Headquarters, Norfolk, Va. Acting President, J. E. White, 7607 Gloucester Ave., Norfolk 5. Secretary, D. E. Phillips, P. O. Box 674, Newport News.

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Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, A. S. Gates, Jr., 621 N. Jackson St., Arlington, Va. Secretary, J. G. Muirheid, 2013 New Hampshire Ave., N. W., Washington 9.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. W. Wolters, 820 Staples Ave., N.W., Kalamazoo 54. Secretary, H. R. Limbacher, 760 E. Vine St., Kalamazoo.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, Edwin Woolcock, 2217 15th St., Niagara Falls, N. Y. Secretary, T. F. Killeen, 374 Delaware Ave., Buffalo 2.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, W. A. Ouweneel, 514 E. Ogden Ave., Milwaukee 2. Secretary, H. F. Brinen, 2226 Kinzie Ave., Racine.

Student Branches

North Carolina State College: Organized 1948. Headquarters, Raleigh, N. C. President, J. G. Marshall, North Carolina State College. Secretary, Basil Greene, Apt. D-2, Grosvenor Garden Apts., Raleigh.

Purdue University: Organized 1948, Headquarters, W. Lafayette, Ind. Chairman, R. G. James, 411 E. 37th St., Indianapolis. Secretary, D. M. Long, FPHA Apt. 423-2, W. Lafayette.

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, S. E. Ammons, 212 13th Ave., No., Texas City. Secretary, C. P. Howard, Box 1706, College Station.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1948 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Separate Moisture, Temperature Control Featured in Conditioner

No. 3921—The new type MC "Unitrane" room unit is a unit air conditioner which is designed to provide separate control of moisture and temperature. According to the manufacturer, The Trane Co., La Crosse, Wis., the chief design feature is the use of two independent air circuits in one cabinet.

One circuit is the conventional coil-fan-filter arrangement and is used for handling recirculated air. The other circuit utilizes a separate coil-fan-filter arrangement and a damper control for regulating the amount of outside air taken into the unit. Control of humidity is accomplished by cooling and reducing the moisture in the ventilation air before it is blended in the unit with the recirculated air.

The special "moisture control" coil used in the ventilation air circuit is made up of a series of cylindrical elements with axial fins. This circuit is said to be designed with sufficient internal resistance to neutralize the effects of variations in outside air pressure.

According to the company, the built-in damper is used to regulate the ratio of outside to recirculated air to meet the requirements of individual rooms. Each room unit is connected to a conventional piping system which may be used to deliver chilled water in summer and hot water for winter heating.

Also available is the new type OC unit which has been developed for use where complete moisture control is not essential. This unit contains one coil (for hot or chilled water) one set of fans, and one filter.

Navy Type Packaged Dehumidifier Is Now Available Commercially

No. 3922—Dry Air Products Corp., 726 Jackson Pl., Washington 6, D. C., has designed a packaged dehumidification unit which is being used aboard naval vessels for various applications such as the initial drying of voids and other compartments in inactive ships and for protecting gun mounts and radar equipment from excessive atmospheric moisture.

The dehumidifier, which has been tested at the Engineering Experiment Station, Pennsylvania State College, is said to have a capacity of over 7 lb of water removed per day (at an entering air condition of 95 deg dry bulb and 35 percent relative humidity) and to incorporate many new features which provide operating economy and simple design.

Now available for the commercial market through the company's sales outlets, the unit is known as the "Dapco" dryer.

Offers Low Range Pyrometer for Use in Panel Heating, Cooling

No. 3923 — A low range surface temperature measuring instrument, the "Alnor" type 500 pyrometer, has been introduced by Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10.

In this pyrometer, a new high sensitivity movement is said to make possible its low range of 0 to 150 F. The instrument is equipped with a manual cold end adjuster. This adjustment can be made by holding the thermocouple against the aluminum test block and turning the cold end adjuster screw until the pyrometer reading duplicates the indications of the thermometer.

The unit was designed for checking the surface temperatures of panels in panel heating and cooling installations but may also be used for other surface temperature applications in this low range.

Designs Six New Controls for Gas Industry

No. 3924—Six automatic gas controls, designed to increase comfort and efficiency, have been introduced by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8.

The new controls, shown for the first time at the re-

FOR YOUR CONVENIENCE

Heating, Piping & Air Conditioning [12-48]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

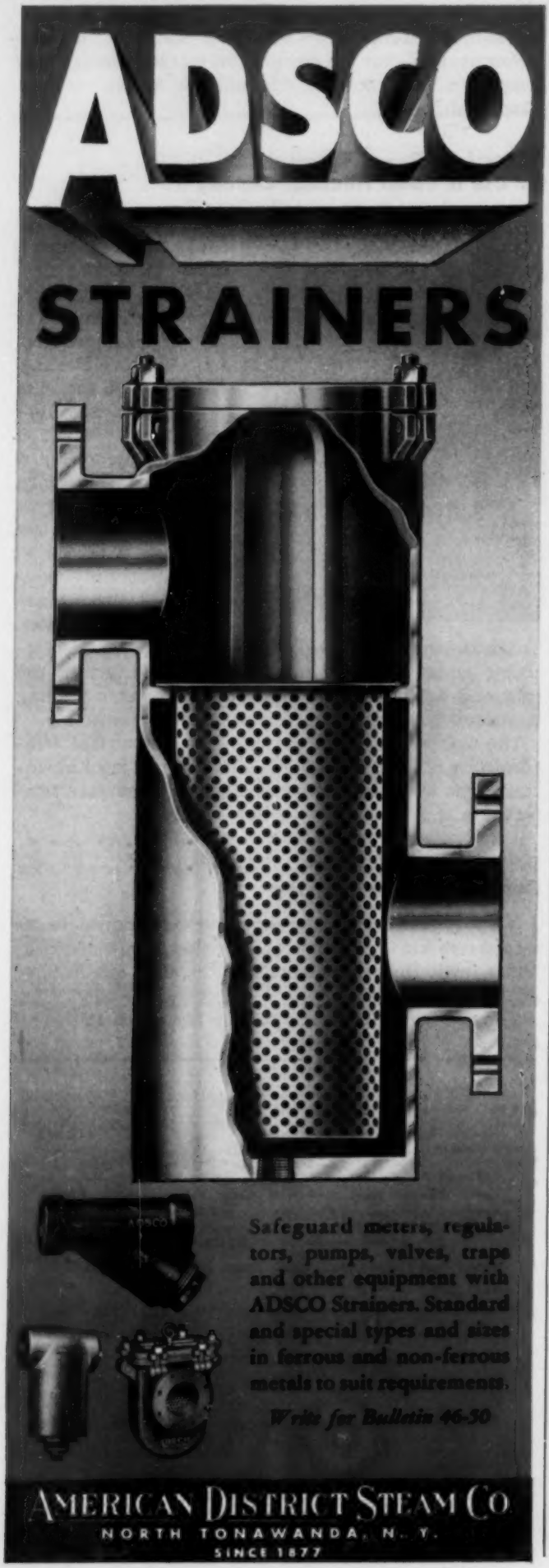
3921 3922 3923 3924 3925 3926 3927 3928 3929 3930
3931 3932
7056 7057 7058 7059 7060 7061 7062 7063 7064 7065
7066 7067 7068 7069 7070 7071 7072 7073 7074 7075
7076 7077 7078 7079 7080 7081 7082

Name ..... Title.....

Company .....

Address .....

City..... Zone..... State.....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STRAINERS
Safeguard meters, regulators, pumps, valves, traps and other equipment with ADSCO Strainers. Standard and special types and sizes in ferrous and non-ferrous metals to suit requirements.
Write for Bulletin 46-30
AMERICAN DISTRICT STEAM CO
NORTH TONAWANDA, N. Y.
SINCE 1877

cent Gas Appliance Manufacturers' Association exposition, include a time modulating thermostat, a plug-in diaphragm valve, an electronic combustion safety control system, the electronic "Moduflow," the "Powerpile" self generating control system, and the plug-in "Chronotherm."

The time modulating thermostat is designed to take into consideration the effects of the cooling period of the space to be heated as well as the heating cycle of the burner.

Said to be compact and especially quiet in operation, the plug-in diaphragm valve is particularly adaptable to floor furnace applications, but can be used wherever this type of control is desired as it is unusually small.

The electronic combustion safety control system has several new features which are being offered to the gas industry for the first time. The system is designed to provide instantaneous cutoff of the gas supply in event of pilot or flame failure and to furnish complete sequence control for automatic ignition burners.

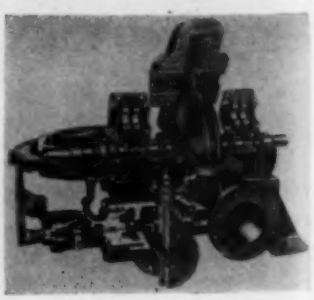
The "Powerpile" self generating control system with automatic pilot incorporates several refinements. One of the most important is said to be the fact that it provides greatly increased power for valve operation, assuring greater reliability. In addition, the system utilizes a new thermostat that is equipped with a mercury switch.

Silicones Used in High Temperature Induction Motor

No. 3925 — Silicone resins for winding insulation and silicone grease for bearing lubrication are said to make possible a new totally enclosed, nonventilated motor in a 5 hp four pole rating in the same frame sizes as an open motor of the same rating. According to the manufacturer, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, this permits reductions of as much as three frame sizes from present standard class A insulated totally enclosed motors. The efficiency, power factor, and torque of the new motor are said to be comparable to those of an open motor of the same rating.

Shown at the left is a new silicone insulated, all steel "Life Line" motor of 5 hp size. The motor at the right, weighing over 70 percent more than the smaller unit, is rated the same but is class A insulated.

General Purpose Steam Turbine Designed for Many Applications

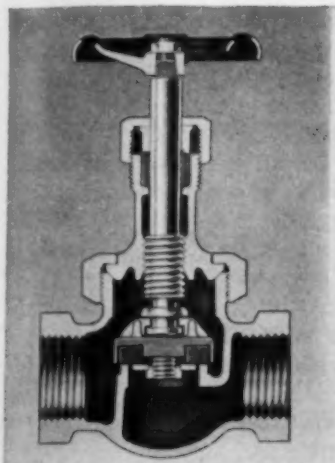


No. 3926—A new all weather general purpose turbine for driving industrial pumps, fans, blowers, compressors, paper machinery, and small generators, the type E, has been announced by Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30.

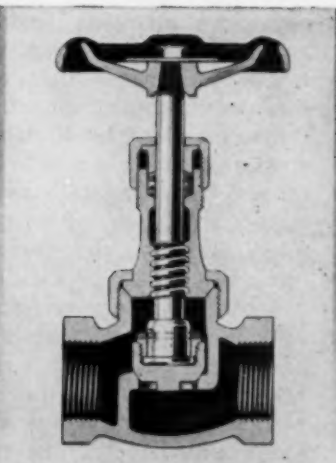
R-P&C VALVES

for low-cost flow control

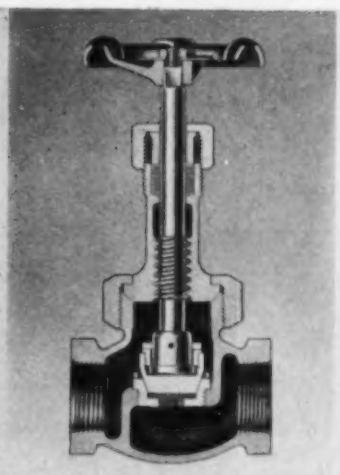
Here are a few of the more popular numbers in Reading-Pratt & Cady's **BRONZE** ***line***



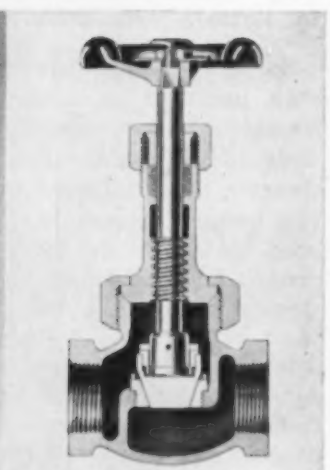
Union Bonnet Globe (or angle). With renewable, interchangeable discs for general services.



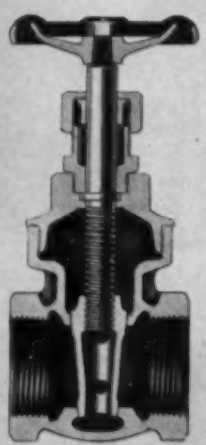
Union Bonnet Globe (or angle). Discs may be reground without removing valve from line. For occasional throttling.



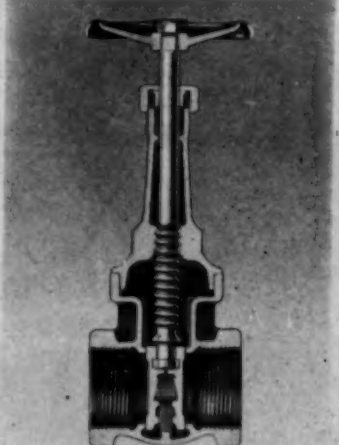
Union Bonnet Globe (or angle). Semi-plug type for frequent throttling service. Renewable copper nickel alloy disc and seat ring.



Union Bonnet Globe (or angle). Full plug type for severe throttling service. Renewable copper nickel alloy disc and seat ring.

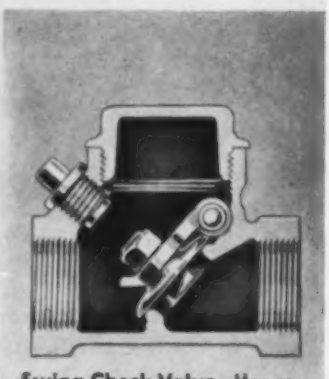


Stationary Stem Gate. Solid wedge renewable. Wedge can be reversed if one side becomes worn.



Rising Stem Gate with double disc. Disc easily assembled or taken apart—yet cannot work out of place.

SHOWN HERE are some of the numbers in the R-P&C line of high quality bronze valves. R-P&C also make iron and steel globe, angle, gate and check valves—iron cocks and Lubrotite gate valves—Bar Stock valves of bronze, carbon steel and alloy steels—cast steel fittings. Get in touch with your Reading-Pratt & Cady Distributor.



Swing Check Valve. Has renewable disc, regrinding seat. Disc free to rotate, thus distributes wear uniformly.

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston
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READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

READING-PRATT & CADY

A choice of three wheel sizes, 16, 20, and 25 in., permits these turbines to be applied over a range of 5 to 1500 hp with steam conditions up to 600 psi ga at 750 F, and speeds of 1000 to 7000 rpm. Equipped with heavy duty parts, the unit is designed to operate at 1500 psi ga at 950 F. Many parts are interchangeable.

Features are said to include combination felt and labyrinth bearing seals to protect the lubricating system from contamination, the use of corrosion resistant materials, and an overspeed trip designed to simultaneously close the governor valve and a heavy butterfly valve at a predetermined speed. The basic turbine is equipped with a shaft type governor and special wide speed range governors are available where required.

Offers Packaged Conditioners for Remote Installation

No. 3927—Two new heavy duty, packaged air conditioners of 10 ton capacity, designed for hotels, stores, theaters, clubs, institutions, and business houses, have been added to the lines produced by Frigidaire Div., General Motors Corp., Dayton 1.

Both units are designed for installation remote from the conditioned area and may be equipped with a heating coil. These self contained units are similar in design and function, except that one model has been developed for use with an evaporative type condenser, recommended for use in localities where the water supply or drainage is limited, where rates are prohibitive, or where ordinances restrict water usage.

The cooling unit incorporates the company's "Multipath" principle of refrigerant distribution. A 10 hp water cooled reciprocating compressor supplies refrigeration to one of the conditioners while a 10 hp evaporative type unit operates the other. Special rubber mountings are used to reduce vibration.

Develops Liquid to Give Fresh Air Effect

No. 3928**—Air Correctives, Inc., 441 Lexington Ave., New York 17, has recently been formed to distribute "Air-Aid," a clear liquid "derived from the distilled essences of plant life" and designed to provide harmless vapors in the air stream of a ventilation or air conditioning system so that occupants will experience a pleasant atmospheric condition.

Manufactured by R. M. Hollingshead Corp., this air treatment liquid is said to permit the use of less outside air and to be especially useful where processing creates unpleasant odors, where outside air itself is contaminated by odors, and where it is not practical to overcome vitiated air by dilution.

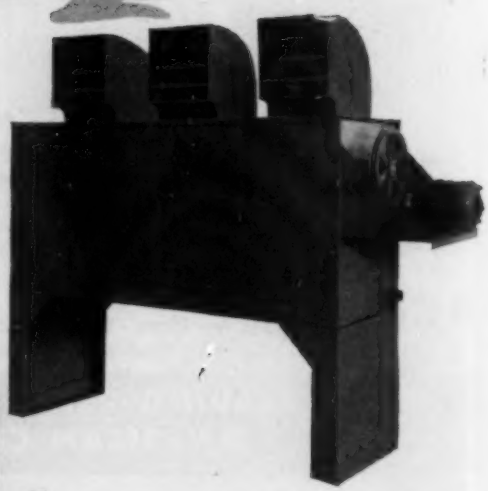
According to the company, it is nontoxic and noninflammable and provides a fresh air effect without perfuming the air. It is sold in drums, gallon bottles, and pint bottles with individual evaporators. A diffuser with no moving parts is available for use with new or existing air conditioning systems.

When You Think of Steam Unit Heaters . . .

Think FIRST of AIRTHERM

Code Tested & Approved Steam Unit Heaters to Meet Every Requirement.

- Horizontal Discharge Unit Heaters
- Vertical Discharge Unit Heaters
- Blower Fan Type Unit Heaters



Airtherm Unit Heaters are available in a complete range of sizes and capacities with Code Tested ratings. Recommended by leading architects and contractors. Sold through recognized wholesalers. For complete details and name of your nearby wholesaler, write.

For Dependable Service, It's Wise to Buy from Your Jobber.

AIRTHERM MANUFACTURING CO.

711 SOUTH SPRING AVE. • ST. LOUIS 10, MO.

DIRECT FIRED HEATERS | PROPELLER FAN STEAM UNIT HEATERS | BLOWER FAN STEAM UNIT HEATERS | CONVECTOR RADIATION

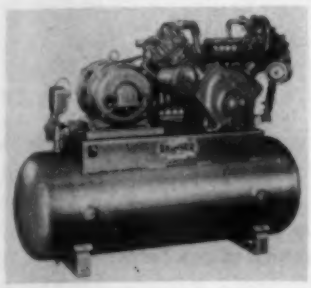
-87

Measures Low Air Velocity

No. 3929—Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, has developed a new "Alnor" thermo-anemometer for measuring air velocities as low as 5 fpm.

The unit employs the principle of the heated thermocouple and includes a direct reading meter and a probe rod attached by a flexible cable. According to the company, it is suitable for a wide variety of uses—wherever an accurate reading under 150 fpm is desired. It is said to be unaffected by air temperature or humidity.

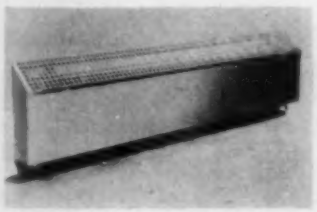
Two Stage Air Compressor Incorporates Improved Design



No. 3930—The new 15 hp air compressor offered by Brunner Mfg. Co., Utica 1, N. Y., is air cooled, operates at slow speed (590 rpm) and is said to incorporate noteworthy improvements in design and construction.

An improved style of tank mounting is designed to distribute the weight of the unit over a wide floor area and the cradle support is used to dampen vibration. Valves, controls, and drain cocks are compactly grouped in manifolds, and motors on all completely assembled units are designed for heavy duty service and are of standard make. Welded air tanks are built of special analysis, open hearth hot rolled steel plate. An automatic air release is used to prevent the motor starting against overload, and the company's "Clozoropen" check valve is said to open wide and to prevent chatter and hammer. Designed for a maximum working pressure of 200 psi, the complete outfit has a tank of 120 gal size.

Steam, Hot Water Convector Is of Wall Panel Type



No. 3931*—A wall panel type convector for steam or hot water has been announced by Rempe Co., 340 N. Sacramento Blvd., Chicago 12.

According to the company, it requires a minimum of space, can be installed above or in the baseboard of an office, factory, hotel, school, hospital, etc., and permits persons to work close to windows in comfort.

It consists of steel or aluminum fins 3 in. wide by 6 in. high, with two steel tube circuits passing through the section. The slanted cover fits close so that the unit can be placed either above or in the baseboard, and sizes range from 18 to 116 in. in length. The height is 8 in. and the depth is 3 in.

Help 4 MILLION Oil Heater Owners to AUTOMATIC Heating Convenience and Oil Savings!

Automatic Control Accessories:

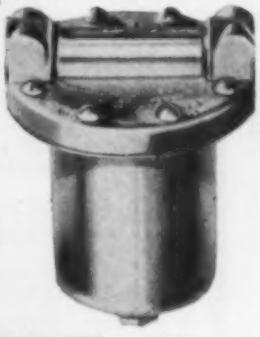
Thermostat Comfort Kit

Includes Thermostat, Conversion Top, Transformer, accessories. Fits most heaters made since 1939 (all using A-P Model 240-DR, UR, YR Manual Controls.)

OILIFTER

Ends oil hauling by hand — "Lifts" oil automatically to ALL vaporizing oil burning appliances.

Fuel Oil TRAP-IT



Cleans fuel oil for better heating. Traps water, gum, dirt, sludge. Saves servicing expense.

This TRAP-IT saves its cost many times over on ANY oil line.

CASH IN NOW . . . On New Sales and Profits . . . with A-P AUTOMATIC OIL CONTROL ACCESSORIES.

Write for complete MERCHANDISING AIDS . . . catalogs, folders, ad mats, slide film booklet, and others.

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DEPENDABLE *Oil Controls*

STANDARD ON LEADING APPLIANCES

The NEXT ISSUE IS

IT!

THE JANUARY 1949 ANNUAL DIRECTORY AND SHOW NUMBER

It'll be out next month! Heating, Piping & Air Conditioning's 16th Annual Directory and Show Number carrying the industry's original, reliable and complete classifications of "who makes it" and "where are they located?"

In addition it will contain the Show Section of the International Heating and Ventilating Exposition here in Chicago, complete with all listings and directions of what is to be displayed at the show and where to find it.

It's a real advertising buy for every manufacturer. It offers advertising that *lives* all year . . . a chance to reach the readers and buyers with a message that packs a full-year advertising campaign wallop . . . and at regular issue rates. Make plans now to take space . . . and lots of it. . . . Show your entire line. Copy service is available.

AS A DIRECTORY . . . The most complete information on who makes it, and where they're located, trade names and products they signify and complete manufacturers addresses.

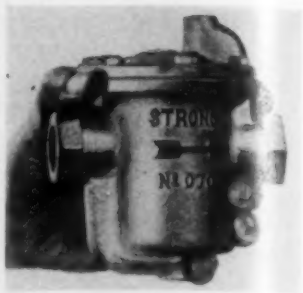
AS A SHOW NUMBER . . . Complete listings of all exhibitors, what they'll display and where to locate them.

AS A JANUARY ISSUE . . . The usual quota of technical articles on heating, piping and air conditioning and the Journal section of the American Society of Heating and Ventilating Engineers.

HEATING PIPING & AIR CONDITIONING

6 N. MICHIGAN AVE., CHICAGO 2, ILL.

Inverted Bucket Steam Trap Handles Light Loads



No. 3932—Strong, Carlisle & Hammond Co., 1392 W. Third St., Cleveland 13, has announced a new, small steam trap, No. 070, designed for standard applications wherever small drainage is a problem.

Available for pressures from 0 to 150 psi, this inverted bucket type unit features a renewable seat, a seamless deep drawn, 18-8 stainless bucket, oversized ports, the company's patented, wear resistant "Anum-Metl" valve and seat, and its "Hi-Cap" orifice.

Some of the manufacturer's recommended applications include laundry and dry cleaning equipment such as pressing machines, tumblers, and dryers; industrial unit heaters (up to 150,000 Btu per hr); kitchen and restaurant equipment such as coffee urns and steam tables; hospital equipment such as sterilizers and autoclaves, etc.

Equipment Shorts

Fedders-Quigan Corp. recently held a national sales clinic at which E. A. Bonneville, sales manager of the unit air conditioner division, announced plans to more than triple sales in 1949. Regional sales managers and distributors were shown demonstration samples of the ¾ and 1¼ hp console models and a window model finished in ivory. Keynote of the plans calls for a drive to sign up distributors and dealers in newly opened sales territories.

The Paducah, Ky., branch plant of Modine Mfg. Co. is currently being expanded by approximately 80,000 sq ft of floor space. The new addition will provide added manufacturing and warehousing facilities and will also include offices.

C. G. Hussey & Co. recently celebrated its 100th anniversary. Officials of the company marked the occasion with ceremonies attended by the president and directors of the parent company, Copper Range Co.

The Great National Air Conditioning Corp., Dallas, is now a subsidiary of United States Air Conditioning Corp. The entire "usAirco" lines of evaporative cooling units and gas products will be merged with those of Great National to give this new division a wider range of products.

Prices of "Freon 11" were reduced last month approximately 2 to 5 percent, depending upon container sizes. The manufacturer, Kinetic Chemicals, Inc., says that wider use of this refrigerant has resulted in production economies which are being passed on.

A special customer service department has been established by Binks Mfg. Co. The new department has been

organized to extend a policy of courteous and prompt attention to inquiries by centralizing all information and its dissemination. It has been established as an independent unit that is not answerable to any other department.

A new apparatus for treating pulmonary disorders resulting from exposure to certain chemicals, gases, or superheated air in industrial processes has been announced by Mine Safety Appliances Co., Pittsburgh. Known as the "Pneophore", this portable instrument consists mainly of three valves, two gages, rubber tubing, and face pieces. It differs from a resuscitator in that it administers oxygen with intermittent positive pressure only. According to the company, suction that could damage lung tissues or other parts of the respiratory system is eliminated. It is designed for use on any oxygen cylinder with a standard thread and may be used for emergency cases of asphyxiation.

A 4000 ton extrusion press, installed during the war at the Huntington works of International Nickel Co., Inc., is now producing pipe of nickel, monel, and other high nickel alloys in diameters up to 9¼ in. and in lengths up to 12 ft. According to the company, these shapes can be further cold drawn into seamless pipes 8 in. in diameter with wall thickness up to ¾ in. and in varying lengths.

A new line of low voltage controllers for use with a-c motors up to 800 hp, at 550 volts, and for d-c motors up to 350 hp, at 230 volts, has been developed by General Electric Co.'s control division, Schenectady 5, N. Y. These metal enclosed units are designed for controlling squirrel cage, wound rotor, synchronous, or multispeed a-c motors, or d-c motors. Common applications for which they are suitable are said to include pumps, mixers, grinders, mills, and similar drives in the heavy industries.

Rapidesign, Inc., P.O. Box 592, Glendale, Calif., is offering a new No. 40 circle template for use in all fields of drafting. Measuring 4 x 7¼ in. and made of 0.03 in. thick cellulose nitrate sheet, the template contains 39 circles grouped in progressive sizes with increments in 64ths, 32nds, 16ths, and 8ths of an inch.

The extension of its line of ballasts for germicidal lamps has been announced by General Electric Co.'s specialty transformer and ballast divisions. Ballasts are now available for the 8, 15, and 30 watt germicidal lamps, the 4 watt lamp with bent U tube and radio type base, the bayonet base T5 lamp for refrigerators and similar appliances, and the 36 in. T6 "Slimline" germicidal lamp.

A newly designed "Rol-Away" tubing truck, has been added to the list of hand trucks manufactured by Beall Pipe and Tank Co., 1945 N. Columbia Blvd., Portland 3, Ore. This four wheel truck is designed for handling pipe, tubing, bar stock, rods, molding, lumber, and other long narrow pieces. It is made of welded aluminum tubing.

FOR

Quality Products
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EXECUTIVE CHANGES

Robert H. Morse, Jr., vice president, Fairbanks, Morse & Co., has been elected a member of the board of trustees of Illinois Institute of Technology. A member of the American Society of Mechanical Engineers, the Society of Naval Architects and Marine Engineers, American Bureau of Shipping, and the general advisory board and Illinois manufacturers' advisory board of the Lumbermen's Mutual Casualty Co., he has been vice president and general sales manager of Fairbanks Morse since 1943.

J. T. Gillespie, Jr., has been made sales manager of Watson-Stillman Co. He joined the firm in 1944 as director of export sales and remained in this capacity until appointed to his new post. He will continue to supervise export sales.

Armco Steel Corp. has named Joe S. Thomas director of purchases and Charles Beck manager of raw materials supply. Mr. Thomas, who joined the organization in 1927, fills the vacancy caused by the death of Newman Ebersole. Mr. Beck joined Armco on a full time basis in 1926 and has been assistant general superintendent of the Middletown division since 1944. His new position was recently established.

General Engineering & Mfg. Co. has appointed John H. Curtis regional manager of its southeast region with headquarters in Augusta, Ga. He was formerly regional representative in the firm's south central territory.

Thomas S. Pendergast is the new general manager of Baker Ice Machine Co., Inc. He will direct the company's overall operations including its two manufacturing plants; the original midwest plant in Omaha and the eastern plant in South Windham, Me.

The election of George N. Lilygren as a vice president of Carrier Corp. has recently been announced. Prior to his association with the company, he had broad experience in factory engineering work as well as factory accounting. He was appointed comptroller last year and will now serve as vice president and comptroller.

Al Bailey is now general manager of Kieley & Mueller, Inc. He will make his headquarters at the company's plant in North Bergen, N. J., but plans to spend considerable time with distributors throughout the country. His appointment is part of an extensive expansion program.

Associated with Tuttle & Bailey, Inc., since January 1946, Robert S. Rickabaugh has been appointed assistant sales manager. In his new capacity he will assist in the sales work of all company products.

The promotion of P. M. Pottetti to the position of sales manager has been announced by Cyclotherm Corp.

Executive Changes (Cont.)

which has also announced the promotion of Guy B. Smith to assistant sales manager in charge of advertising and sales promotion.

Roy C. Yantis is now general sales manager of Henry Valve Co. He joined the firm last November as assistant sales manager.

Lyle A. Christensen, general sales manager of Marley Co., Inc., has recently been appointed a vice president. He was a sales engineer in the company's New York office for five years, moved to the home office in 1946, and became general sales manager in 1947.

Following a recent directors' meeting, Remington Corp. has announced the election of Fred Stidfole as vice president. Other recent personnel additions include the appointments of Leonard Clark as design engineer and of Howard Peters as assistant sales manager.

General Electric Co. has reorganized its chemical department and has announced a number of new appointments, according to Harold F. Smiddy, general manager of the department. Dr. Charles E. Reed is now engineering manager of the department and Robert L. Gibson is assistant general manager. Harry K. Collins and John L. McMurphy have been appointed to managerial posts of the plastics division and the chemicals division respectively.

Ludwig Skog, senior partner of Sargent & Lundy, Chicago consulting engineers, has been elected to membership on the board of trustees of Illinois Institute of Technology, according to an announcement by Henry T. Heald, president.

W. A. Siegfried, president of Superior Valve and Fittings Co., is the new secretary of the Refrigeration Equipment Manufacturers Association. He is a member of the American Society of Refrigerating Engineers, a member of the board of directors of REMA, chairman of its public relations committee, and a member of various other committees.

George R. Milne has been named operating manager of National Carbide Corp. He joined the firm in 1941 and since 1946 has been works manager. Russell T. Lund, plant superintendent at Louisville since 1941, has been named assistant operating manager.

Edmund T. Flanagan, manager of the New York sales division, Fairbanks Co., has been appointed manager of regional sales in addition to his present position. He has been with the company for over 31 years.

Globe Steel Tubes Co. has elected Harry K. Ihrig vice president and director of laboratories. He is the holder of numerous patents on petroleum refining and metal-

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lurgical processes and is the author of a text on the metallurgy of iron and steel, as well as many technical papers. Lee Mullen, general manager of sales, has been elected vice president in charge of sales.

C. I. MacGuffie and R. C. Freeman have been named manager of sales and manager of engineering, respectively, of the General Electric Co. welding divisions. Mr. MacGuffie has been manager of sales for the company's welding equipment division, and Mr. Freeman has been division engineer for d-c welders at the Fitchburg, Mass., plant.

T. Spencer Shore, 45 year old industrialist and investment banker, has been elected president of Eagle-Picher Co. and will assume office the first of next month. Joel M. Bowlby, who has been president since 1941, is chairman of the board and will continue as chief executive officer and general manager of operations. Joseph Hummel, Jr., who has been associated with the firm for 57 years and board chairman since 1941, has been appointed honorary chairman. Elmer Isern, formerly vice president of Eagle-Picher Mining and Smelting Co., has been elected president of that subsidiary.

William Furber Smith, former engineering director of the Manhattan Project wartime research unit of Carbide and Carbon Chemicals Corp., has joined United States Testing Co. to organize a new engineering inspection service in conjunction with building and building material. The new service will be integrated with the company's chemical and engineering laboratories.

M. G. McGregor, recently named sales manager of Ahlberg Bearing Co., is now directing sales activities in the company's 14 branch offices. He has been with the organization for 22 years and prior to this promotion was manager of bearing replacement sales.

K. C. Goodrich has been appointed sales manager of General Refrigeration Div., Yates-American Machine Co., Beloit, Wis. He has been with the division for a number of years and was assistant to the sales manager prior to his promotion.

Describes General Procedure for Designing Air Conditioning Systems

Air Conditioning Design, by H. C. Hoffmann, Carrier Corp., and G. B. Priester, Consolidated Gas, Electric Light, and Power Co., describes, in its broadest concept, the general procedure for an air conditioning system and explains the various parts of a system. After defining a number of air conditioning terms, the authors briefly cover the design goal, heat loads, load calculations, zoning, air distribution, refrigeration, and controls.

Published by the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, this five page leaflet is designated as Application Data No. 44, costs 40 cents.

NEW BOOKS & REPORTS

Basic Principles Stressed in Text on Public Health

Public Health Engineering, by Earle B. Phelps, professor of sanitary science, Columbia University, deals with principles rather than with engineering practice. It is written for the public health (or allied) engineer who, the author assumes, knows how and what to design but not why. Being a treatise on public health engineering it includes essentially nothing on heating, ventilating, or air conditioning for process or quality control. Also, since the subject is so very broad, the treatment of any one phase of it must of necessity be brief and general.

This book may be of interest and of value to heating, ventilating, and air conditioning engineers, not so much for what it contains on heating, ventilating and air conditioning (the ASHVE Guide and other related publications are better in this respect) but for what it contains in regard to all other related fields of comfort and health engineering. The specialist in heating, ventilating, and air conditioning is prone to lose sight of these related fields in his quest for more knowledge in his relatively narrow field of specialization.

This book is the first volume of a two-volume treatise on this very broad subject. Vol. I is devoted to the field of environmental sanitation which is divided into two sections, the first section dealing with the air contact and the second section with the water contact. The author was assisted in the preparation of this book by two able collaborators. Chapter 8 on insects and insect control was written by Harry D. Pratt of the U. S. Public Health Service, and chapters 9 to 16 inclusive, which constitute the second section of Vol. I, were written with the help of Professor Clarence J. Velz of Manhattan College.

The first seven chapters of Vol. I, and possibly chapter 8, deal with subject matter which is of interest to engineers engaged in heating, ventilating, and air conditioning. These chapters cover the subjects of man and his environment; weather and climate—housing; the air supply of enclosed places; the thermal environment of the human body; heating, ventilating, and air conditioning; illumination and lighting; and atmospheric pollution—noise. The third, fourth, and fifth chapters are most closely related to the field of our activity. Chapter 3 includes brief discussions on the ventilation problem as affected by air chemistry, air vitiation by human occupancy, air bacteriology, and industrial atmospheric contaminants; on the measurement of temperature, humidity, air movement, and air contaminants, both living and nonliving; on equivalent conditions of warmth; and on comfort and health. In chapter 4, the author reviews the physical laws of gases and of heat transfer and discusses briefly the physiological and physical principles that govern heating and cooling of (and thermal balance in) the human being. Chapter 5, which is entitled Heating, Ventilating and Air Conditioning, contains brief discussions of such subjects as practical atmospheric standards of temperature, humidity, air movement, air quantity, and air quality for the maintenance of health, comfort, and efficiency. The

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author's remarks on ventilation practice cover ventilation by dilution, influence of room volume, natural and mechanical ventilation, air conditioning, air disinfection, and local exhaust ventilation for the control of industrial atmospheric contaminants.

The second section of the book deals primarily with water supply and waterborne waste disposal. This is of interest only to those few heating and ventilating engineers who are curious about the whole scheme of what might be called comfort or health engineering.

Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, and priced at $7.50, the book is clothbound and contains 655 + ix pages.—Reviewed by Allen D. Brandt, industrial hygiene engineer, Bethlehem Steel Co.

Revised Pump Standards Include Pipe Friction Data

The Hydraulic Institute, organized in 1917, is a trade association composed of manufacturers of displacement and centrifugal pumps. Its Standards, first issued in 1921, are published as a service to engineers, buyers, and users of pumps, as well as to its own members.

The recently issued eighth edition of the Standards contains pertinent technical and engineering pump data and is a complete revision, published with the cooperation of some nonmember pump manufacturers, the American Society of Mechanical Engineers, and other groups. Separate sections on centrifugal, rotary, and reciprocating pumps provide data on nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which each type is designed.

The data section contains a number of charts giving information on the friction loss of various types of paper stock in cast iron pipe. Also included are tabulated data on materials commonly used for pumping various liquids. A page in questionnaire form should be of interest to pump users as it indicates the type of information (with regard to liquid handled and the use of a pump) required by a manufacturer for the proper selection of materials.

An entirely new 82 page section on pipe friction contains many tables and charts giving data on friction losses for water flowing in schedule 40 steel pipe or in asphalt-dipped cast iron pipe, the resistance to flow of any fluid (liquid or gas) by pipe friction, resistance to flow caused by valves and fittings, the viscosity of fluids, properties of water at various temperatures, and properties of cast iron and wrought steel pipe.

This section is the result of an investigation undertaken during 1946 and 1947 to revise the data contained in earlier editions. The new material is based on a paper, Friction Factors for Pipe Flow, by Lewis F. Moody, professor of hydraulic engineering, Princeton University, and published in the 1944 ASME Transactions. The pipe friction data are presented as a tentative standard and comments are invited.

Paper covered copies (8½ x 11 in.) of this eighth edition may be obtained from the Hydraulic Institute, 90 West St., New York 6, for $3.00.

Fundamentals for Industrial Applications Included in Warm Air Heating Manual

Warm Air Heating and Winter Air Conditioning has

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been prepared as a guide for the student and the artisan in the fundamentals covering the installation and servicing of all types of warm air heating equipment. The author, John W. Norris, vice president, Lennox Furnace Co., devotes the major portion of the manual to residential heating and leads off with simple definitions of terms used, a description of various types of heating systems (stressing the advantages of warm air heating), and the reasons for good construction.

Information on heat loss factors is taken from data compiled by the American Society of Heating and Ventilating Engineers and the National Warm Air Heating and Air Conditioning Association. The design procedure set forth is in agreement with that of the association.

The chapter on commercial and industrial warm air installations contains a brief discussion of intermittent heating and outside air requirements. The basic principles and the procedure for designing duct systems by the equal friction method are described, and data are given on register and grille capacities, rectangular equivalents of round ducts, and friction losses in inches of water per 100 ft. As an introduction of the subject to the student and artisan, the chapter serves a useful purpose. However, detailed information for the engineer seems to be lacking, as correction factors for pipe roughness, information on the pressure losses in elbows and fittings, and the pressure loss effects of turning vanes are not covered.

This volume contains 320 (8 x 11 in.) pages. Prepared and published by the engineering department of Lennox Furnace Co., Marshalltown, Iowa, it is priced at $5 and may be obtained from the company's sales offices.

Other Books and Reports Received

Specifications for Arc Welding Electrodes—Industrial users of arc welding will be interested in four specifications recently completed by the committee on filler metal, jointly sponsored by the American Welding Society and the American Society for Testing Materials.

Tentative Specifications for Mild Steel Arc Welding Electrodes and Tentative Specifications for Low Alloy Steel, Arc Welding Electrodes represent a division of the old tentative specifications. The low alloy specifications include all classifications in the E70, E80, E90, and E100 series, whereas the mild steel specifications include all classifications in the E60 series. Classifications have been added in both specifications to cover the so called "low hydrogen" electrodes.

Tentative Specifications for Corrosion Resisting Chromium and Chromium-Nickel Steel electrodes, first issued in 1946, has been expanded so that 40 classifications covering 85 percent of the stainless electrodes now used are included.

Tentative Specifications for Copper and Copper Alloy, Metal Arc Welding Electrodes is the first in a series to be issued for copper and copper alloy filler metal. It includes classifications for copper, phosphor-bronze, copper-nickel, copper-silicon, and aluminum-bronze.

Individual copies of these specifications are available from either AWS headquarters, 33 W. 39th St., New York 18, or ASTM headquarters, 1916 Race St., Philadelphia 3. The price is 25c each.

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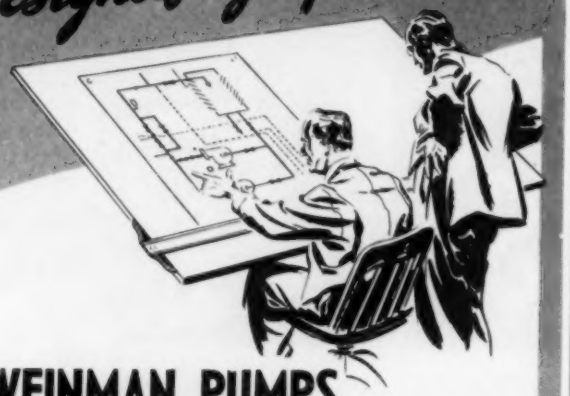

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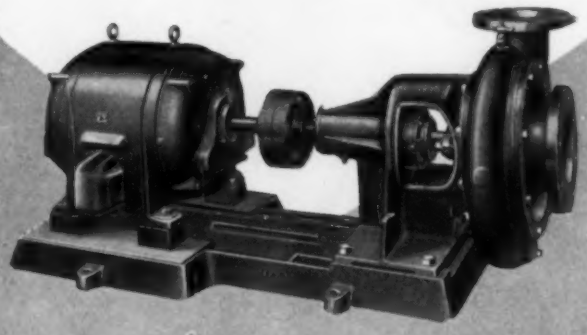

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MEETINGS & CONVENTIONS

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—35th annual convention, Hotel Cleveland, Cleveland, December 9 and 10. Current problems and the industry's overall objectives will highlight the meeting.

American Standards Association, 70 E. 45th St., New York 17, has announced that a private five day seminar on the organization and technique of standardization work, particularly in individual companies, will be held, January 24 to 28, in room 503, Engineering Societies Bldg., 29 W. 39th St., New York City. The seminar will consist of 10 conferences and will be conducted by Dr. John Gaillard, mechanical engineer on the ASA staff and lecturer at Columbia University. Detailed information on registration can be obtained by writing to Dr. Gaillard at 400 W. 18th St., New York 27, or at ASA headquarters.

Ninth International Heating, Ventilating, and Air Conditioning Exposition, January 24 to 28, International Amphitheatre, Chicago—under the auspices of the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City.

Under the management of the International Exposition Co., Grand Central Palace, New York 17, this event will be the largest of its kind ever held, according to Charles F. Roth, show manager. More details are given in the ASHVE Journal Section of this issue.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City—the 55th annual meeting, January 24 to 27, 1949, Stevens Hotel, Chicago.

The Illinois Chapter will be host for the occasion and W. A. Kuechenberg is in charge of arrangements. For additional information see ASHVE Journal Section in this issue.

National Heating Wholesalers Association, 239 Water St., Pittsburgh—annual convention and membership meeting, January 25, Blackstone hotel, Chicago. Dick Colegrove, association secretary, has urged members to secure early reservations from the hotel because of a probable scarcity of accommodations.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago—plans have tentatively been made to hold a one day membership conference in Chicago during the last week in January.

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.—the following 1949 meetings have been scheduled:

Spring meeting and ASTM committee week, Edgewater Beach hotel, Chicago, February 28 to March 4.

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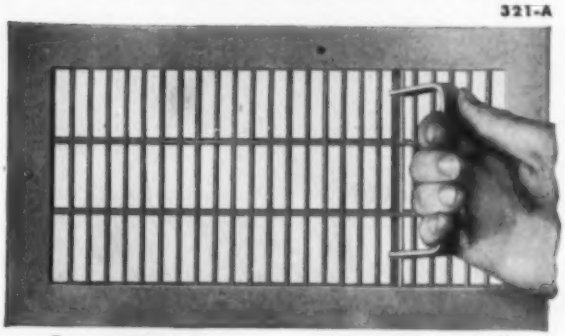

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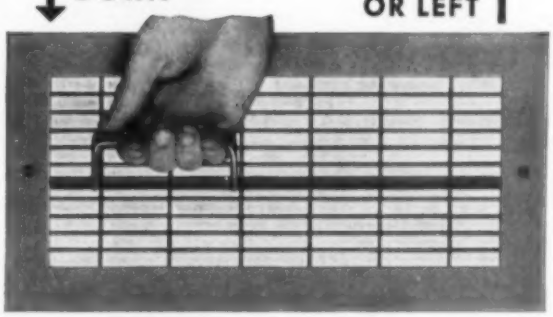

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Meetings & Conventions (Cont.)

Fifty-second annual meeting, Chalfonte-Haddon Hall hotel, Atlantic City, June 27 to July 1.

First national meeting of the society on the west coast, Fairmont hotel, San Francisco, October 10 to 14.

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—Indoor Comfort Conferences will be held during February, March, and April, in 10 cities located in Michigan, Indiana, Illinois, Minnesota, Nebraska, Missouri, New York, and Ohio. Each of the conferences, more familiarly known as warm air heating schools, will consist of a three day instruction program.

American Foundrymen's Society, 222 W. Adams St., Chicago—1949 annual meeting, May 2 to 5, St. Louis, Mo.

Oil-Heat Institute of America, 6 E. 39th St., New York City—1949 national convention and National Oil-Heat Exposition, May 16 to 20, Boston. The convention committee has approved Mechanics Hall for the exposition and the Statler as the headquarters hotel.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6—40th annual meeting, New Ocean House, Swampscott, Mass., May 24 to 27.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—Proposed 1949 Spring meeting, June 5 to 8. As tentatively planned, the technical sessions and committee meetings will be held aboard ship and will be combined with a cruise, from Montreal, on the St. Lawrence and Saguenay rivers. Stops for sightseeing will be made at Murray Bay, Tadoussac, and Quebec.

The 4th International Gas Conference, June 15 to 17, London, England—sponsored by the International Gas Union which is comprised of national gas associations throughout the world. Papers and discussions will cover all phases of gas making, including manufacture, distribution, utilization, research, and statistics. Participants at the conference are also invited to attend the 86th annual meeting of the Institution of Gas Engineers, to be held in London, June 13 and 14. Additional information may be obtained from the American Gas Association, 420 Lexington Ave., New York 17.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—1949 semi-annual meeting, June 20 to 22, Minneapolis.

Sixth All-Industry Refrigeration and Air Conditioning Exposition, the week of November 14, 1949, Atlantic City—sponsored by the Refrigeration Equipment Manufacturers Association, 1107 Clark Bldg., Pittsburgh 22, Pa.

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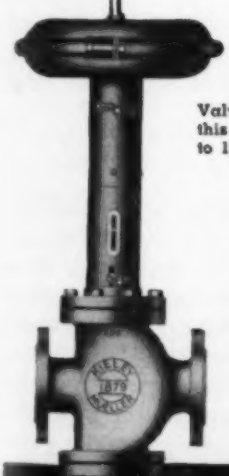
Adjustment of throttling range can be made while unit is in operation and full valve travel with float movement from 1" to 8" can be obtained.

A wide combination of float units and valve sizes may be used. Request Bulletin 1000 from Kieley & Mueller, North Bergen, New Jersey.



Valve sizes for this service up to 16".

The Kieley & Mueller policy of continued pioneering has helped the K&M reputation grow constantly throughout the past 69 years. Look to K&M for: BACK PRESSURE REDUCING VALVES • PRESSURE REDUCING VALVES • STRAINERS • ATMOSPHERIC RELIEF VALVES • STOP AND CHECK VALVES • STEAM SEPARATORS • GREASE EXTRACTORS.

KONTROL KIELEY & MUELLER MOTOR

NORTH BERGEN N.J.

New Condenser Cuts Refrigeration Costs Saves Cooling Water

● The Niagara Aeropass Condenser cuts the cost of refrigeration by running compressors at lower head pressure, saving up to 35% of power. It uses no cooling water.

The refrigerant gas passes thru two coils in an air stream. The first, "Duo-Pass" dry coil, removes the super heat by air cooling and condenses oil vapor. The second, condensing coil, drenched by recirculated water spray, condenses by evaporation, transferring to the air 1,000 BTU for every pound of water evaporated. This done at low temperature, no scale forms on condenser tubes to clog air passage.

Between the two coils is the "Oilout", which purges the system of crankcase oil and dirt, keeps it always at full capacity.

The "Balanced Wet Bulb" control holds head pressure at the practical minimum. It automatically proportions the fresh air stream to the condensing load with the full benefit of power-saving on cool days, providing full capacity for peak loads.

Niagara Aeropass design results from over fifteen years' experience condensing by air. It is completely trustworthy for year' round operation. Users say, "It saves half the difficulties and labor of running a refrigeration plant."

Units range from 10 to 100 tons capacity.
For full information ask for Bulletin 103.

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. HP, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

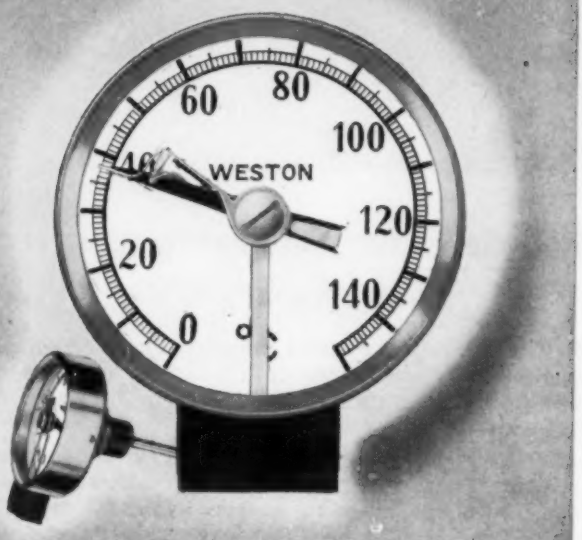
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

NEW—

all-metal WESTON

Contact-making

thermometer



This new Weston combines the features of an indicating device with the advantages of an alarm or control instrument. A contact arm, mounted as shown above, is easily set to make contact at any temperature on the scale.

A terminal block on the periphery of the case makes electrical connection easy. The thermometer is all-metal, typically WESTON in ruggedness and reliability, with accuracy of ±1% as an indicating thermometer, and ±1½% as a contact making device. It is supplied in two types—for operation on either increasing or decreasing temperatures.

For complete information see your local WESTON representative or write Weston Electrical Instrument Corporation, 648 Frelinghuysen Avenue, Newark 5, New Jersey.

Industrial Thermometers | MAX-MIN Thermometers | Contact-making Thermometers

WESTON *Thermometers*

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 157. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Air Conditioning and Refrigeration Equipment

No. 7056—Airtemp Div., Chrysler Corp., Dayton 1, has published a 12 page booklet covering its line of heating, air conditioning, and refrigeration equipment. Among the products described and illustrated are packaged conditioners, window type conditioners, commercial refrigeration condensing units, a packaged liquid cooler, central system cooling equipment, and marine refrigeration condensing units.

Air Conditioning in Hospitals and Offices, ASHVE Research

No. 7057—The Vol. 4, No. 3 issue of the house organ published by Anemostat Corp. of America, 10 E. 39th St., New York 16, leads off with a discussion of some of the factors entering into the design of hospital air conditioning. Next follows an article on the air conditioning system in the office building of the Container Corp. of America. A brief discussion of research being done by the American Society of Heating and Ventilating Engineers is also included as is the third part of an article on sound control.

Bending Machines

No. 7058—Bending machines for wire, rods, notched angles, pipe, tubing, bars, etc. are briefly described and illustrated in a four page leaflet issued by Wallace Supplies Mfg. Co., 1300-08 Diversey Parkway, Chicago 14.

Blower Wheels, Assemblies and Fan Blades

No. 7059—A leaflet describing the centrifugal blower wheels, blower assemblies, and propeller fan blades offered by Burden Co., 1000 N. Orange Dr., Los Angeles 38, covers design and construction features and shows some of the combinations available.

Branch Pipe Outlets for Welding

No. 7060—Bonney Forge & Tool Works, Allentown, Pa., has issued a 24 page illustrated catalog on "WeldOlets" for branch pipe outlets. Complete information on these fittings is given, and three types are described. One is for butt welding, one is for socket welding, and the third, "ThredOlets," is for threaded connections. Installation instructions, sizes, dimensions, weights, prices, temperature and pressure ratings, and material specifications are included. The last three pages of the booklet cover the company's various drop forged flanges.

Cabinet Type Unit Heater

No. 7061—The new Webster-Nesbitt series R unit heater is of the cabinet type and is designed for low noise level applications. Manufactured by John J. Nesbitt, Inc. and

SELF-CLEANING ACTION — Sliding Plastic seat wipes orifice clean at each cycle.

• Here's a new idea in accurate, positive, economical water-flow control for your water-cooled compressors (up to 6 H.P.) . . . A self-cleaning valve that just can't be stopped by dirtiest water. Dirt, lime, scale and other impurities are simply wiped off the stainless steel orifice every time the sliding plastic seat moves. Avoids all common troubles due to dirt and impurities in cooling water.

Model 65 controls the water flow in exact proportion to head pressure needs. When head or receiver pressure exerted on the heavy, two-ply bellows is greater than the preset force of the adjustable steel spring in the lower section of the valve, the composition valve slide moves down across the stainless steel orifice to release the water flow. As pressure drops, valve moves to the closed position. Simple in operation, compact in size for installation in small space, A-P Model 65 Water Regulating Valve is easy to adjust to the system by means of adjusting stem in the bottom. Special hydraulic O-ring seals prevent water leakage into spring and bellows domes, and all parts contacting water are corrosion-proof for long-life service. Operating head pressure, 65-180 lbs.; maximum water pressure, 150 lbs., ⅜" inlet and outlet.

For economy's sake—and for more efficient refrigeration —use the A-P Model 65 Water Regulating Valve on every water-cooled job.

Stocked now at all good refrigeration equipment wholesalers. Write for bulletin.

AUTOMATIC PRODUCTS COMPANY

2460 North Thirty-Second Street • Milwaukee 10, Wisconsin
Export Dept. 13 East 40th Street, New York 16, N. Y.

DEPENDABLE REFRIGERATION VALVES

STOCKED AND SOLD BY GOOD REFRIGERATION WHOLESALERS EVERYWHERE . . . RECOMMENDED AND INSTALLED BY LEADING REFRIGERATION SERVICE ENGINEERS.

PATTERSON-KELLEY HOT WATER STORAGE HEATERS

Make it a "Copper-Lined" Heater and Save Money

We can and do manufacture hot water storage heaters of **all** commercially used metals. We make them of both ferrous and non-ferrous solid metals. But more and more the trend with our customers is towards copper-lined heaters.

The copper-lined heater offers just as much corrosion resistance or rust-prevention as solid copper or copper silicon. It is made to the same strength requirements and with the same factors of safety. **But it provides economy of construction** not possible with the solid non-corroding metals.

On your next hot water storage heater job, ask us about our copper-lined heaters. We'll be glad to quote on your specifications but do suggest you inquire of the "lined" heater as an alternate.

EST. 1880

THE PATTERSON-KELLEY Company, Inc.

107 WARREN STREET, EAST STROUDSBURG, PA.

New York Office: 101 Park Avenue, Zone 17
Offices or Representatives in Principal Cities

distributed by Warren Webster & Co., Camden, N. J., it is described and illustrated in a 12 page booklet identified as Publication No. WN-133.

Charts for Finding Heat Loss in Burned Fuel Gases

No. 7062—Janitrol Div., Surface Combustion Corp., Toledo 1, has prepared a group of four nomographs for determining the relationship between the CO_2 content of flue gases, the temperature rise of the gases, and the flue loss in percent. The four charts cover manufactured gas, natural gas, propane and butane, carburetted water gas (high and low specific gravity), and Nos. 1 and 3 fuel oil.

Chemical Treatment of Water for Air Conditioning

No. 7063—The Vol. 17, No. 9 issue of the house organ published by W. H. & L. D. Betz, Gillingham & Worth Sts., Philadelphia 24, leads off with an article on the chemical treatment of water used in air conditioning systems. Stating that these systems have their own special water treatment problems, the article gives information on scale, corrosion, and slime and describes recommended treatments for several typical air conditioning systems.

Chlorine

No. 7064—A new technical manual on chlorine, issued by Columbia Chemical Div., Pittsburgh Plate Glass Co., Fifth Ave. at Bellefield, Pittsburgh 13, present charts, diagrams, and illustrations concerning the production and handling of chlorine and several of its end products. Included are detailed discussions of manufacturing methods, handling and unloading, safety precautions, etc. The 72 page booklet also contains information on the properties of chlorine and the preparation and analyses of several bleach liquors.

Condensate Return Units and Pumps

No. 7065—Roy E. Roth Co., Rock Island, Ill., has recently issued a number of new bulletins. The type UA packaged condensate return unit, featuring the company's turbine type pump, is covered in Bulletin No. 199. The type XA packaged boiler return unit is featured in Bulletin No. 200 and Bulletin No. 103 describes the new "Monobilt" pump, where pump and motor are combined into one unit. The company's heavy duty flexible coupled pumps, special metal pumps, and a series of industrial pumps, are described and illustrated in Bulletin 101. All bulletins include general catalog data, specifications, and prices.

Corrosion in Boiler Systems

No. 7066—A 12 page article discussing the cause and prevention of corrosion in boiler systems is featured in a bulletin identified as Technical Paper No. 111, issued by W. H. & L. D. Betz, Gillingham & Worth Sts., Philadelphia 24. The corrosive effects of oxygen, CO_2, ammonia, hydrogen sulfide, acidity, and physical factors are evaluated.

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ALL REDWOOD TYPE "WS"
NATURAL DRAFT COOLING TOWER

Binks Type "WS" Redwood Cooling Towers will provide efficient, trouble-free service on any industrial application. Ready for shipment in 30 standard sizes, ranging from 10 to 1200 GPM.

The product of expert engineering and workmanship throughout, Binks Type "WS" Redwood Towers are prefabricated for easy field assembly by ordinary labor without skilled factory supervision. Recommended for cooling condenser circulating water from refrigeration and air conditioning compressors, water-jacketed machinery, and wherever cooling of water or other liquids is required.

Send now for Bulletin No. 40, giving full information on sizes, specifications and capacities of Binks Type "WS" Redwood Cooling Towers. State tower capacity required.

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VALUABLE BOOKLET . . .

"RADIANT HEATING and COOLING"

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Made up of articles and data on this subject that appeared originally in "Heating, Piping & Air Conditioning," this booklet is the most comprehensive and authoritative collection of information on radiant heating and cooling yet assembled. It tells exactly what radiant heating is, where it can be used, and how to design complete systems. In addition, it contains fully detailed descriptions of numerous panel heating and cooling installations.

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84 pages — 8½" x 11" — $1.00

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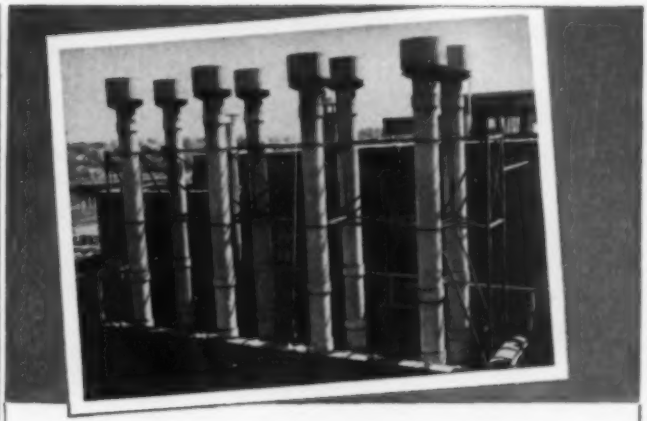
Chicago 2, Ill.



Records show long service in tough service . . .

for Transite Industrial Vent Pipe

Workable: Transite can be cut and drilled on the job.

IN INSTALLATIONS in many industries where corrosive fumes, vapors, dusts, and gases are encountered, Transite Industrial Vent Pipe is yearly demonstrating the fact that it is a practical, economical answer to tough venting problems.

Because it is an asbestos-cement product, this strong, durable pipe stands up in many types of corrosive service . . . helps avoid costly replacement . . . results in important reductions in plant maintenance.

Easily installed—Transite Industrial Vent Pipe has many practical installation advantages. It is light in weight and easily handled. It is readily worked and can be quickly cut and drilled on the job with ordinary tools.

Adaptable: A complete line of Transite fittings meet most requirements.

Easily adapted—Made in a range of sizes up to 36" in diameter, Transite Industrial Vent Pipe is readily adapted to use as vents, ducts, and stacks. A full line of Transite fittings provides a venting system that is corrosion-resistant throughout.

Economical to maintain—Transite is completely rustproof . . . highly weather-resistant . . . needs no painting . . . resists corrosion outside, inside and all the way through. For full details about Transite Industrial Vent Pipe, write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville TRANSITE Industrial Vent PIPE

Zallea Expansion Joints Rate . . .

First Choice!

THE Zallea Stainless Steel Expansion Joint shown above is one of several used in the process steam distribution line of a large Western refinery . . . installed for dependable, economical operation.

In refineries, in power plants, in chemical process plants—throughout industry—Zallea Expansion Joints are rated *first choice* as the ideal medium for absorbing movement in pipe lines due to thermal changes. These features tell why more and more engineers and designers insist on Zallea when they want the best:

- *More economical than expansion bends*—the cost of insulating and installing a bend alone is frequently more than the cost of a Zallea Expansion Joint.
- *No maintenance*—having no packing they may be used in underground lines without manholes.
- *Low thrust against anchors*—require only 1/10 the force required to compress some slip type expansion joints.
- *An expansion joint for every type of service*—special types for combined axial and lateral movement.
- *Shorter face to face dimensions*—enables installation in close quarters.
- Elements may be made of stainless steels, copper, or any other metal required.
- Hydraulic method of forming assures uniform wall thickness throughout corrugations.
- As easy to install as an ordinary flanged or welding fitting.
- Traverse range from fractions of an inch up to 7½" in a single unit and 15" in a double unit.
- Pressure range from vacuum to 300 lbs. in standard units. Up to 1000 lbs. in special units.
- Temperature range from sub-zero to 1600° F.

Catalog 47 contains complete information on all Zallea Expansion Joints. We would be pleased to send you a copy. Write today! Zallea Brothers, 816 Locust Street, Wilmington 99, Del.

Zallea

EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Crayons for Determining Temperatures

No. 7067—"Tempilstiks" are crayons used for determining temperatures in connection with welding, flame cutting, tempering, forging, casting, molding, drawing, and heat treating. The manufacturer, Tempil Corp., 132 W. 22nd St., New York 11, has issued a folder describing these crayons and covering the various temperature ranges for which they are suitable. Also described are the company's pellets and a liquid offered for similar use.

Electronic Flame Failure Control Panel

No. 7068—Haney Gas Burner & Engineers, 909 S. Myrtle Ave., Monrovia, Calif., has issued a four page bulletin on its electronic flame failure safety control panel. This unit is a sequence control and a combustion control combined with a burner operating relay, an ignition transformer, a fused switch, a single pole switch, and a 3 in. gutter mounted on a heavy steel panel. When installed in conjunction with the company's detector pilot, it is said to provide complete automatic operation of the firm's gas burner.

Fractional Horsepower Motors

No. 7069—Redmond Co., Inc., Owosso, Mich., has recently issued an eight page catalog covering its entire range of fractional horsepower motors sold under the trade name "Micromotors." In sizes, these units range from 1/500 to 1/15 hp. They are made in both open ventilated and totally enclosed models, as well as in drawn steel and cast cases.

AIR-FLO
AUTOMATIC
CEILING SHUTTER
FOR ATTIC FAN
Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 73" long. No operating mechanism shows. Built-in fusible link. Meets fire underwriters requirements.
WRITE FOR NEW CATALOG 43-D
Illustrations and details of the complete AIR-FLO line.
AIR CONDITIONING PRODUCTS CO.
2340 W. LAFAYETTE BLVD. · DETROIT 16, MICH.

Said the engineer to the president

No Maintenance Cost
Worry-Free Service
The Most Advanced Welding Process

that's why I'm specifying

Trentweld* Stainless Steel *Tubing

On all types of piping jobs where high temperature or corrosive action must be considered, future trouble can be avoided by installing stainless steel tubing. You know that . . . but from an engineering point of view you may not be familiar with the specific advantages of Trentweld stainless steel tubing.

To begin with, Trentweld is no sideline product. It is produced in light-weight, thin-wall form in diameters from ⅛ inch to 30 inches, by a mill exclusively devoted to stainless tubing. This work-horse tubing is rolled and machine-welded by an exclusive process that makes it tougher, structurally stronger. It is sized to make-up with standard fittings for vanstoned or welded joints, provides you with tubing that makes installation work a time-saving, smooth-running job while it delivers the service you have a right to expect.

Call on Trentweld engineers, without obligation, for specific information, or write for the Trentweld Data Bulletin.

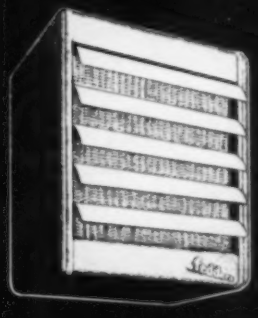
District Offices — Chicago, New York

TRENT TUBE COMPANY

Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA
430 Church Street, East Troy, Wisconsin

How FEDDERS UNIT HEATERS *are Built to Give* SERVICE

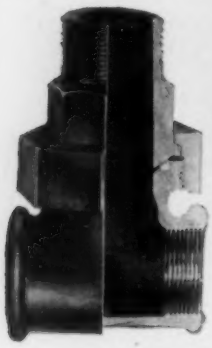
Write for catalog giving complete specifications



● Part by part, you can depend on Fedders advanced engineering. All copper heating element with streamlined tubes and patented saddle fins assure thermal and aerodynamic efficiency. Fins saddled over sides of tubes eliminate expansion stresses between fin and tube. Each tube is free to "give" laterally thus relieving differential expansion stresses between adjacent tubes. Fins are brazed to headers through die-formed flanged holes.

FEDDERS-QUIGAN
CORPORATION
BUFFALO 7 NEW YORK

Leakproof-Permanent
Low Cost-Fast Work



IT'S THIS EXCLUSIVE RECESSED BRASS SEAT that means JOINTS THAT STAY TIGHT!

. . . when you use

JEFFERSON SPECIALTY UNIONS

This exclusive feature provides virtually a one-piece permanent, leakproof construction because the recessed brass seat is integral with the iron of the fitting. This is accomplished by locating the seat away from the runway of the fitting and by grinding the seating surfaces together in pairs to assure a self-seating joint which can be made up *tight* with minimum pressure.

Jefferson Specialty Unions are made in all types for your piping needs. Please write us now for more detailed information.

JEFFERSON UNION CO.

607 West 26th Street, New York 1, N. Y.

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VENTILATING FANS

GB fans • manufactured for industrial ventilating and heating • fume extraction • forced draft • induced draft • Air-conditioning • drying and processing, are of forward or backward curved wheel design.

Type F.C. are designed for quiet operation at low speeds. Type B.C. are designed to operate at high speeds and have the non-overloading characteristics.

Capacities of 200 c.f.m. to 300,000 c.f.m. are covered by standard sizes and arrangements.

The heavier constructions of classes II, III and IV cover the particular needs of special applications.

Send for Bulletin SC-103.

"LUNGS FOR INDUSTRY"

GENERAL BLOWER CO.

8610 Ferris Ave. Morton Grove 16, Ill.

Engineering Offices In All Principal Cities

Gage for Determining Pipe, Conduit Size

No. 7070—A gage for determining the size of pipe, conduit, or metallic tubing is covered in a specification sheet issued by Three Point Industries, 3767 N. Racine Ave., Chicago 13. Said to measure sizes from ⅛ to 12 in., the device is also designed to indicate drill sizes for tapping and incorporates an inch and metric rule.

Gas Flow Meter for Metallizing Spray Guns

No. 7071—Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y., has developed the "Metco" type GF gas flow meter unit which is designed to assure maximum efficiency with proper flame balance, higher spraying speeds, and gas savings in the operation of metallizing guns. The meters are illustrated and briefly described in a new catalog sheet (No. 401).

Gas Welding and Flame Cutting Equipment

No. 7072—The extensive line of gas welding and flame cutting equipment offered by Victor Equipment Co., 844-54 Folsom St., San Francisco, is described and illustrated in color in a new 40 page catalog (Form 20B). Equipment covered includes oxygen and acetylene regulators, torches, nozzles, cutting tips, and numerous accessories.

History of Utica, N. Y.

No. 7073—Brunner Mfg. Co., Utica 1, N. Y., maker of air compressors and refrigeration condensing units, has

HANEY GAS BURNERS

Haney Venturi Gas Burners are the answer to all your heating installations whether commercial, domestic, or industrial. The vertical type illustrated will afford economical, even, dependable heat with remarkable freedom from maintenance troubles. It's shipped completely assembled, ready for installation and is available for mixed, natural or LP gases.

We'll be glad to send more information on request . . . please write!

HANEY GAS BURNER AND ENGINEERS

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BEACON

CONVECTOR RADIATION

BEACON CONVECTORS contain many new features. Guaranteed leakproof because every unit is tested, by both hot water and air, under 150 lbs. pressure. Tubes are silver-brazed on the bronze header forming a complete rust-proof unit. New built-in damper allows complete closing of grille, quickly shutting off heat.

UNIT HEATERS

BEACON UNIT HEATERS possess all the features necessary for highly efficient, trouble-free performance. Fundamentally correct in both design and construction.

- Expansion cracks prevented by free-floating elements in casing.
- All parts coming in contact with steam made of copper.
- Cabinets made of heavy gauge welded furniture steel.
- Resilient base standard motors used.
- Adaptable to all types of construction.
- Wide range of capacities.

WRITE FOR CATALOG

BEACON-MORRIS CORP.
60 Brainerd Road
BOSTON 34, MASS.

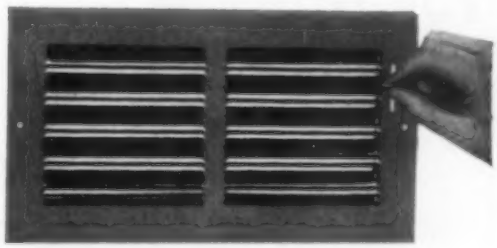
You Can Get It QUICKER from STEWART

HIGH VELOCITY OUTLETS

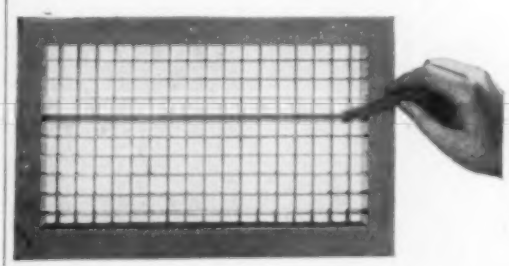
Engineered for Dependability—Flexibility

The Stewart line of high velocity outlets, scoopaires, wall and baseboard registers meet the most exacting requirements of air conditioning, heating and ventilating systems. Special types and sizes speedily produced to order —all standard equipment promptly delivered.

Style 94
Wall or Ceiling Register
Multiple Damper Lever Regulated



Size 94 is designed for wall or ceiling use, with horizontal face bars which are down deflecting. The rear bank of the Style 94 Register serves to regulate the air supply and to deflect air into the outlet. Lever operated multivalves control the degree of opening.

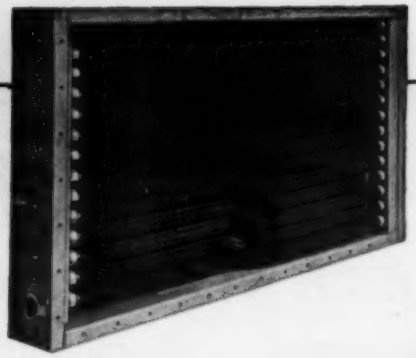


Style DDH
Double-Directional 2 Banks —adjustable face and rear bars.

Style DDH Stewart High Velocity outlet with "All-Way-Selective-Air-Throw" produced by means of a removable key which can adjust any bar at various angles without affecting the setting of any other bar. Horizontal face bars and vertical bars in rear, are both adjustable for any combination of air direction desired.

Send for literature and prompt quotation on your requirements.

Stewart
MANUFACTURING COMPANY, Inc.
612 BLOOMFIELD AVE. BLOOMFIELD N. J.



G&O COILS

FOR HEATING AND COOLING IN A WIDE RANGE OF SIZES

Send for Catalog

THE G & O MANUFACTURING COMPANY
New Haven, Connecticut
Pioneer Manufacturers of Square Finned Tubing in the United States

published, as a goodwill gesture, an 11 page booklet on the history of its community. Written primarily to inform citizens of Utica, the booklet covers historical highlights from 1798 to 1948.

Lubricated Plug Valve

No. 7074—Section 5 of Valve Reference Book No. 39 has been released by Homestead Valve Mfg. Co., Coraopolis, Pa. This four page bulletin covers the company's "Self-Seald" lubricated plug valve and offers general catalog data, descriptions, specifications, etc.

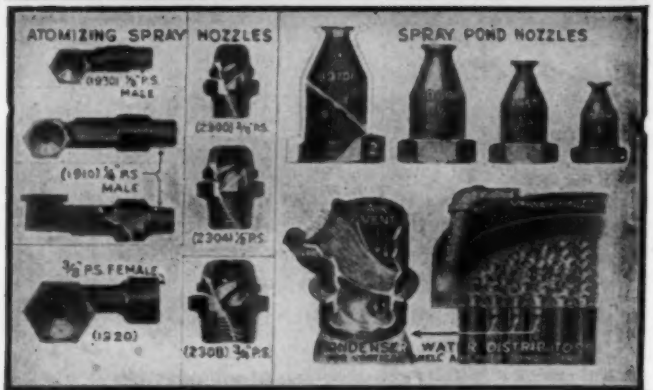
Magnetic Starters

No. 7075—Bulletin 4110, on the new line of a-c magnetic starters of the across-the-line, nonreversing type, is now available from Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y. This eight page bulletin gives information on applications, size classifications, construction features, and dimensions.

Pneumatic Control System

No. 7076—A complete air actuated control system is presented in a 24 page catalog (No. ND4B) issued by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44. The equipment described is said to enable users in the oil, chemical and other industries, to obtain fast start up, small process swings, no process drifts, long on-stream runs, fast recovery from upsets, and short turn-around time. Diagrams and test curves show how this system provides proportional action and automatic droop correction as well as stabilized rate action.

QUALITY always wins!
MARTOCELLO Products are fully DEPENDABLE



ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

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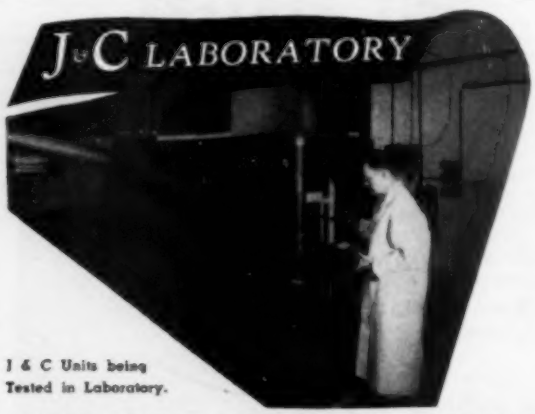
Serving the Ice Industry Since 1916 "There is no Substitute for MARTOCELLO QUALITY"



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PROVES PERFORMANCE

PRECISE MEASUREMENT . . . Of exact static pressure drop across each J & C unit and proper blower size for each J & C Model.
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ONLY IN THE LABORATORY . . . may technicians definitely establish:
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NO GUESSWORK . . . The J & C laboratory, working for you, permits accurate installations because performance capabilities are precisely determined.

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J & C, America's largest and most complete Warm Air Heating Line, offers over 100 types and sizes with outputs from 3,800,000 down to 100,000 Btu in the Famous Tubular Series . . . other models down to 52,500 Btu. Exact engineering plus endless testing provide the J & C features that give you an "edge" when you specify or install J & C.

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Automatic

REZNOR

Gas Fired Unit Heaters

December outside but June inside

- FULLY AUTOMATIC
- EXTRA LARGE FAN
- SPECIAL HEAT EXCHANGER
- STRONGER CONSTRUCTION
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- LOW COST INSTALLATION
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Because Reznor units have proved to automatically and effortlessly provide June's temperatures in December's cold, more Reznor heaters have been sold than any of similar type. SELL REZNOR—the leader. Installs easily and quickly. Brings top quality prices and profits. Write today for catalog.

A SIZE FOR EVERY NEED

NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

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8 UNION ST., MERCER, PENNA.
Gas Heaters Since 1888

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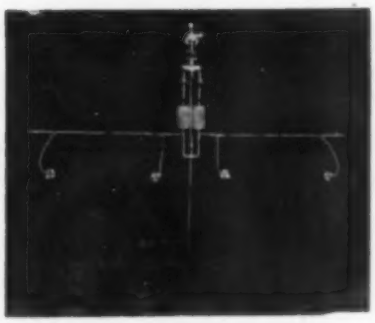

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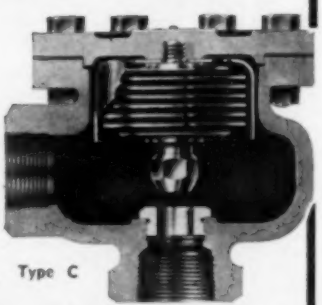
Larger, At-Bottom Valve Keeps Nicholson Traps Clean

Valve orifices of Nicholson steam traps are 2 to 6 times larger than in average traps, minimizing chances of plugging. And, valves being at the bottom, dirt drops out by gravity. This ability to self-clean is one of the features resulting in the unequalled discharge capacity of Nicholson traps. 5 types for every purpose; size ¼" to 2"; pressures to 225 lbs. Test trap gladly sent.



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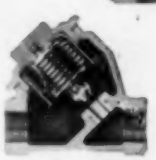

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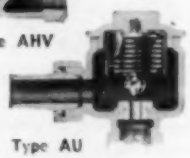

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Finer Performance with Oil or Gas

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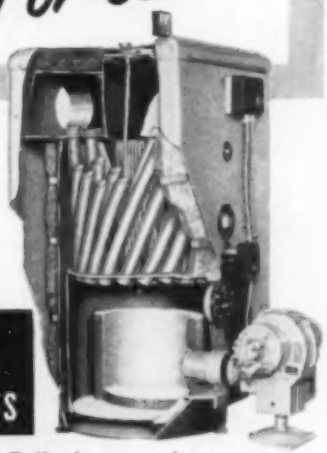

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Power Factor

No. 7077—A 20 page, pocket sized booklet (No. 200-TEC-1077) on power factor and what to do about it explains the essentials of power factor in industrial plants and gives a digest of calculations as well as an explanation of why and how low power factors should be corrected. The booklet is published by Electric Machinery Mfg. Co., Minneapolis 13.

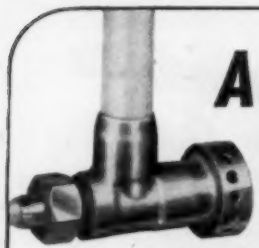
Pressure and Vacuum Gages

No. 7078—Catalog No. 7000 on pressure and vacuum gages has recently been issued by Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Wayne & Roberts Aves., Philadelphia 44. Among the numerous instruments covered are indicating and recording pressure gages, a recording flow meter and pressure gage, an air operated controller, nonindicating pressure controller, an indicating furnace pressure controller, a precision pressure regulator, etc. Also covered are pressure actuating elements, high vacuum gages, and control components.

Pressure Reducing and Regulating Valve

No. 7079—Bulletin No. 265 on the type B pressure reducing and regulating valve is now available from A. W. Cash Valve Mfg. Corp., Decatur, Ill. This eight page bulletin includes recommendations covering installations and also contains capacity charts for water, air, and steam.

Automatic Liquid Feed without Moving Parts



Injector with Distributor Head

Injector and Surge Drum Assembly

THE PHILLIPS INJECTOR provides completely automatic evaporator feed with *no moving parts*. By supplying recirculated liquid steadily to the evaporator it increases heat transfer and increases the evaporator capacity.

Many existing dry-expansion evaporators can be easily changed to Injector operation, with improved performance assured.

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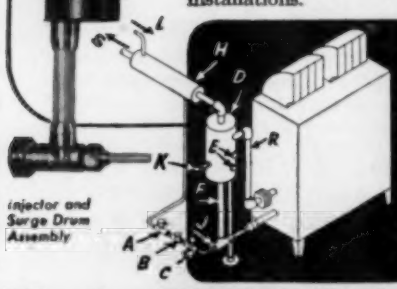
Write for sketches showing typical Injector installations.



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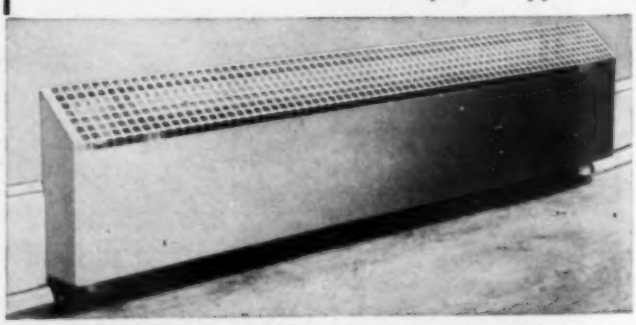

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·ECONOMICAL ·EASY TO INSTALL

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Work goes faster when you *bend on the job* — either original installation, radiant heat or repair. Fewer joints to leak in the future, less friction, more satisfaction for your customers and a bigger profit for you. Do as hundreds everywhere are already doing. Write for illustrated data bulletin. Dept. 13

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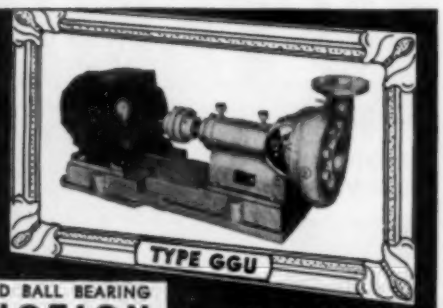

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Capacities to 1400 G.P.M. Heads to 190 Ft.

Wherever liquids play an important or incidental part in industrial processing, this Aurora Type GGU serves perfectly and with lasting efficiency. Because the casing is separate from the bearing bracket, the need for special metals to handle corrosives is minimized. Discharge may be placed in any of eight positions. We commend these pumps for high satisfaction and economy.

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For high pressure, small capacity requirements (up to 150 g.p.m.). Wide operating range characteristics. No metal to metal contact. Handles non-lubricating liquids without wear. Only one moving part — the Impeller.

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HORIZONTAL SPLIT CASE
Single & Two Stage
SIDE SUCTION
VERTICAL
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MIXED FLOW
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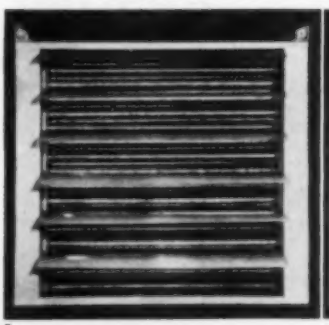

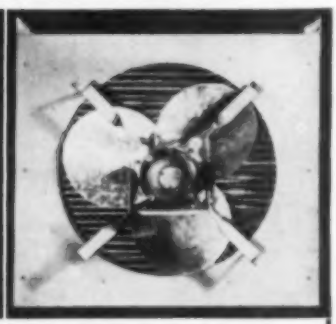

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Chicago Fan unit heaters made for low or high pressure steam

Coil tested at 450 # Hydrostatic Pressure

We use the same coil in our unit heaters as used in our blast coils.

This coil has been on the market for 20 years in all types of plants, and thoroughly proven

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All Parts Accessible

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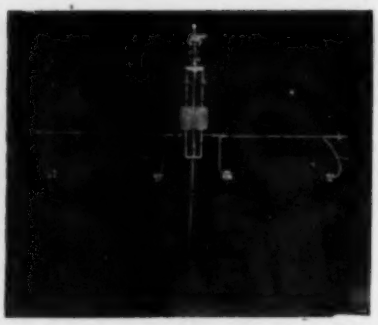

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● (cleans chemically) steam and water systems. Removing sludge, scale and rust safely and economically.

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● *conjunctive* scale control *automatically.*

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● Chemical combustion control increases boiler efficiency — minimizes smoke and soot.

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NOT THIS

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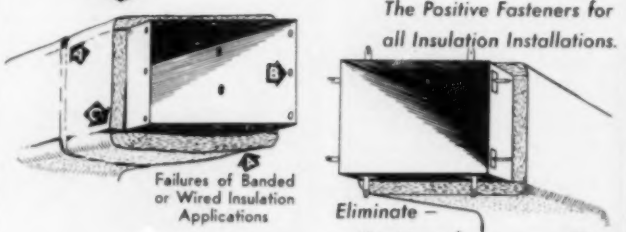

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Fire Hazards
A. Sag and Shearing
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Transportation Map

No. 7080—A transportation map of the United States has been published by the Wolverine Tube Div., Calumet and Hecla Consolidated Copper Co., 1411 Central Ave., Detroit 9. The map, said to be the first of its kind, shows highways, railroads, airlines, principal cities, towns, and villages.

Turbine Pump for Small Diameter Deep Wells

No. 7081—A new "Champion" turbine pump for small diameter deep wells, designed to handle capacities up to 5000 gph from depths up to 200 ft, has been developed by Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave., 26, Los Angeles 31. According to the company, this unit fills the gap (in water production from deep wells 4 in. in diameter and larger) which is often found between domestic water systems and the larger types of deep well turbine pumps. The unit is described and illustrated in Bulletin B-200.

Water Tube Power Boilers

No. 7082—International Boiler Works Co., East Stroudsburg, Pa., has issued a new eight page folder covering its latest water tube power boilers, type "CR." Units are designed for use with coal, gas, or oil, are available in standard sizes up to 300 hp in working pressures of 100, 125, and 150 psi, and are designed and built in accordance with the ASME power boiler code.

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FOR FAST, EASY, ACCURATE DESIGN OF AIR DISTRIBUTION . . .

Why spend many valuable hours in chart reference on large air conditioning duct work installations when the information you need is quickly available on the Air Duct Calculator. This new, handy instrument will instantly and easily give you rectangular equivalents of round ducts, recommended duct velocities, friction loss in 1½ R elbows, weights, etc. It's new and practical and just the time saver you need. Price $2.00 postpaid.

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STANDFORATED
PERFORATION OF ALL METALS

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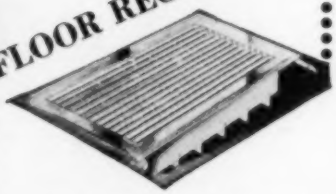

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more free air space
no loose parts
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COLD AIR FACES TO MATCH

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Well established and experienced sales engineers to represent prominent manufacturer of heating, cooling, and air conditioning equipment in the following cities and territories:

Atlanta	Amarillo	Birmingham	Buffalo
Dallas	Des Moines	Detroit	El Paso
Omaha	Eastern Iowa	W. Virginia	North and South Dakota

In reply, give full details of organization and present lines handled. Address Key #767-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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For nationally advertised line of OIL and GAS WARM-AIR FURNACES

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COMMERCIAL REFRIGERATION SALES MANAGER. Old established York Distributor located in North Carolina has opening for experienced Sales Manager to assume complete responsibility for formulating and executing sales activities. Only man thoroughly experienced in refrigeration and air conditioning who has proven executive and sales ability will be considered.

The man we want now has responsible sales managerial position and is successful but wants to go further with an organization with unlimited possibilities.

Liberal salary plus override on sales volume. Give full details of experience and qualifications. Interview will be arranged. Address Key #764-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

HEATING AND VENTILATING ENGINEER. Graduate engineer, with at least 5 years' experience in the design of heating, ventilating and air conditioning systems wanted by manufacturer of unit heaters, convectors, coils and air conditioning units; located in Chicago-Milwaukee area; salary commensurate with ability. Address Key #761-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

SALES ENGINEER—Old established York Distributor located in North Carolina has opening for experienced Refrigeration and Air Conditioning Sales Engineer. Must be capable of passing examination state board of engineers and securing license in Air Conditioning Engineering. If not now a resident of N. C. interim license may be arranged pending examination. Write, stating experience, qualifications, and salary and commission expected. Address Key #763-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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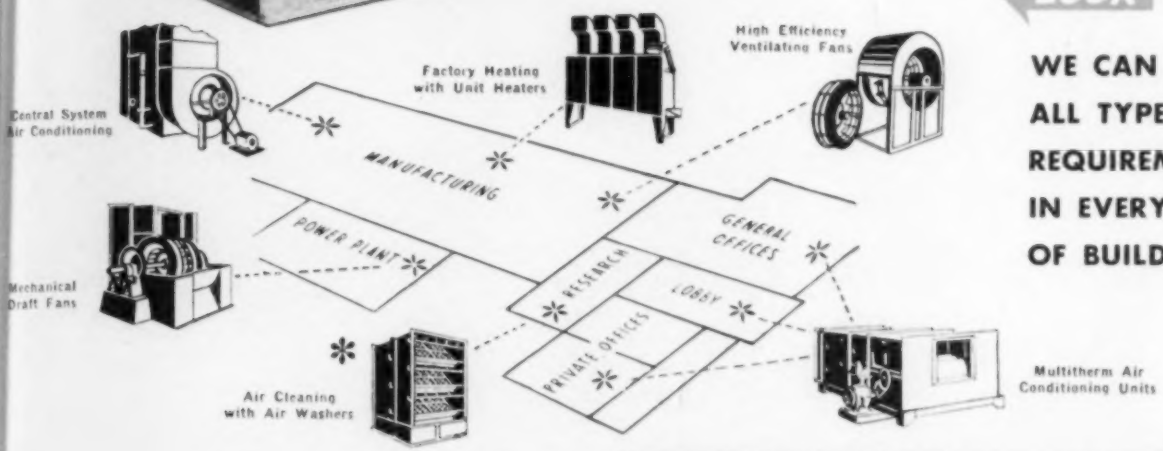

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